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DYNAMIC SAM ENDGAME MODEL, VOLUME 2. USER'S MANUAL.(U)

SEP 77 M A DLOOGATCH, R H ROSE, D S KLUK N62269-76-C-0386

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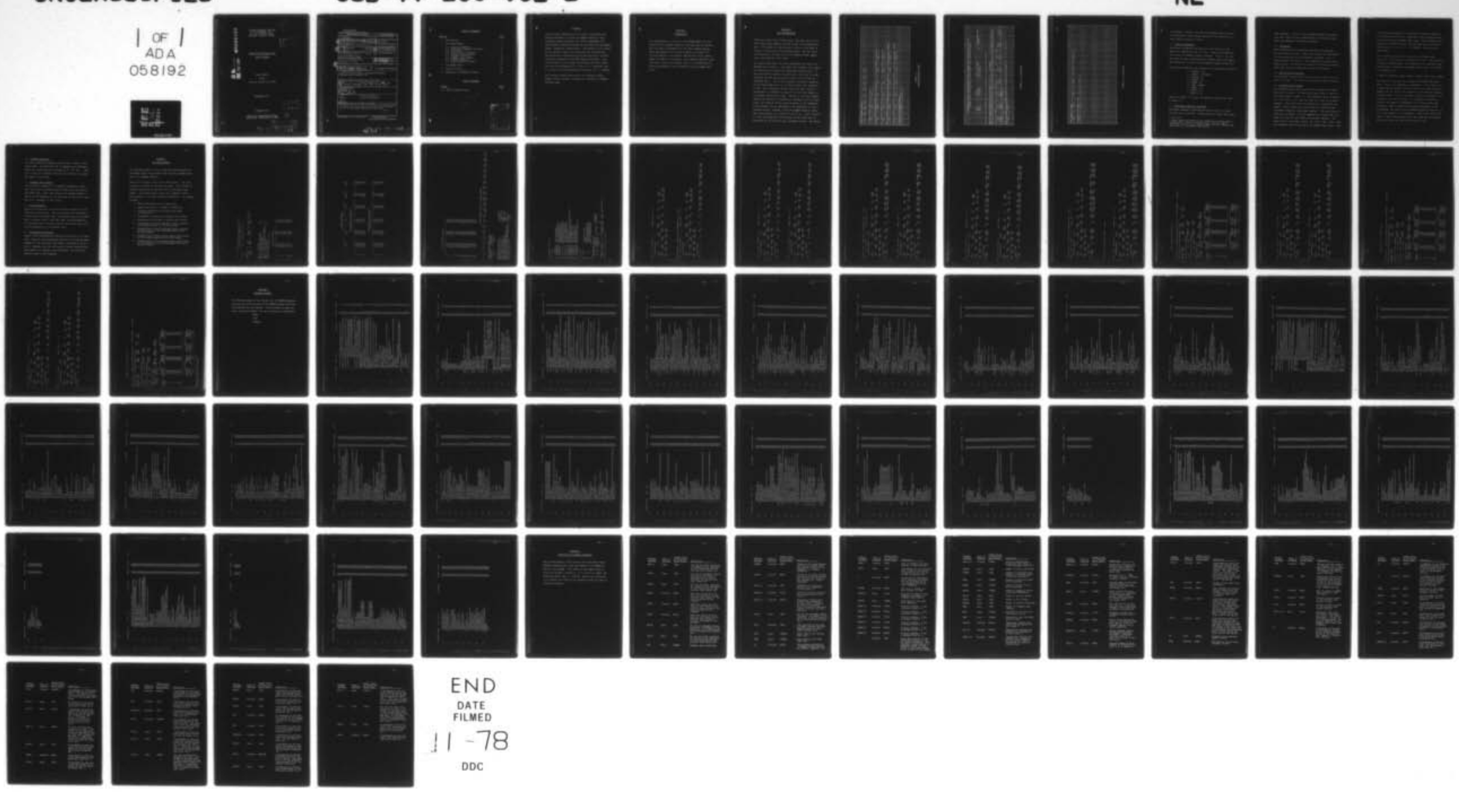

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CAYWOOD-SCHILLER DIVISION
A. T. KEARNEY, INC.
100 South Wacker Drive
Chicago, Illinois 60606

DYNAMIC SAM ENDGAME MODEL

USER'S MANUAL

FINAL REPORT

Under

Contract N62269-76-C-0386

SEPTEMBER 1977

Prepared for

NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA 18974

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Procedures for using a model for evaluating kill probabilities associated with trajectories and intercept conditions generated by the NADC Dynamic SAM Model are described.

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v.1 - A058 050
(97-200 on card)

FOREWORD

The activities described in this report in modifying the Dynamic SAM Model to include an endgame capability were performed during the period July 1976 to September 1977 under Contract N62269-76-C-0386 for the Naval Air Development Center, Warminster, Pennsylvania. The purpose of this effort was to develop a means for evaluating kill probabilities associated with trajectories and missile/aircraft intercept conditions generated by the NADC Dynamic SAM Model. This is the second of two volumes constituting the final report. The work was performed by R. H. Rose, M. A. Dloogatch, and D. S. Kluk of the Caywood-Schiller Division of A. T. Kearney.

This volume includes instructions for preparing inputs, sample outputs, program listings and a glossary of FORTRAN variable names.

SECTION 1

INTRODUCTION

As a prerequisite to the use of the DSAMAM model with the addition of an endgame capability the user must be familiar with the input requirements for the basic DSAMAM program. These requriements are covered in detail in Volume II of the Final Report on the Dynamic SAM-Aircraft Study, Report Number C9-2336/120, Autonetics, North American Rockwell Corp. This User's Guide will confine itself to the additional operating requirements which accompany the new endgame capability.

SECTION 2

DATA REQUIREMENTS

There are twelve sets of input cards, each made up of one or more cards, which comprise the new inputs to the DSAMAM program. The format for these inputs is shown on the forms in Figure 2-1 and each set is discussed below. The new inputs are inserted in the data for the old DSAMAM program immediately following the title cards.

All inputs other than the control parameters are read in as FORTRAN real variables. This means that normally they should be entered with an explicitly designated decimal point. If they are entered without a decimal point, they must be right-justified and the implied decimal point will be after the rightmost digit. All of the Cartesian coordinates requested on the input forms are to be in the aircraft body coordinate system. This coordinate system, under the name "stability coordinates," is defined on page 3-22 of the Final Report on the Dynamic SAM-Aircraft Study. Because in the basic DSAMAM program the aircraft is essentially considered to be a single point, the location of the origin relative to the components of the aircraft is not specified in the definition of the coordinate system. However, since the endgame addition represents the aircraft in a variety of ways (e.g., a set of points or a set of ellipsoids) the location of the origin must be specified for the aircraft body coordinate system. The choice

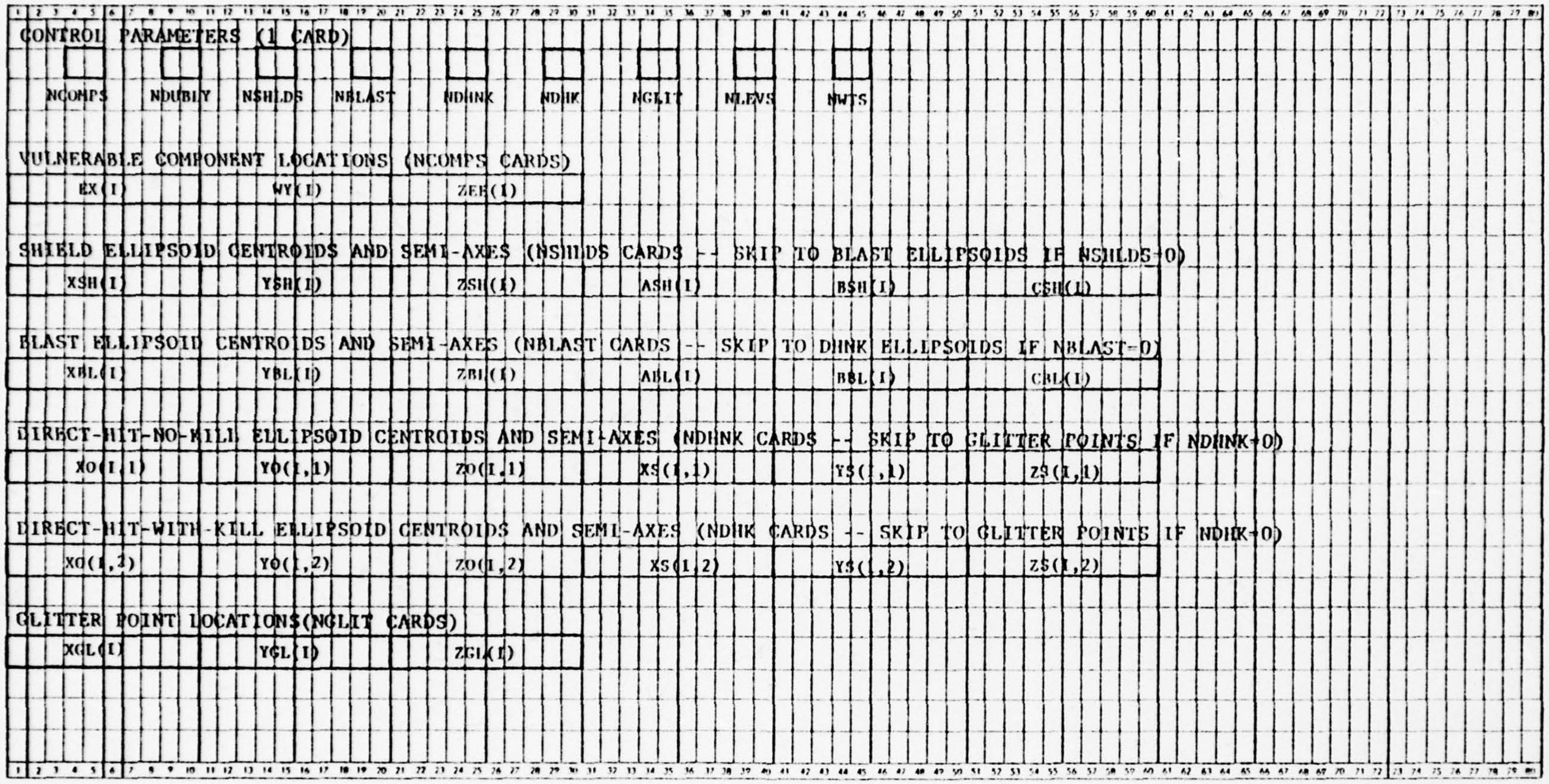

FIGURE 2-1

DSAMAM ENDGAME INPUTS

VULNERABLE AREA TABLES (6*NCOMPS*NWTS*NLEVS CARDS) VULNERABLE AREA AS A FUNCTION OF KILL LEVEL, COMPONENT, ASPECT, MASS CLASS AND NET STRIKING SPEED. DATA IS NESTED AS FOLLOWS:

NLEVS KILL LEVELS	NCOMPS VULNERABLE COMPONENTS	6 ASPECTS (BOTTOM, TOP, LEFT, RIGHT, FRONT, REAR, IN THAT ORDER)	NWTS FRAGMENT MASS CLASSES

FOR EACH KILL LEVEL-COMPONENT-ASPECT-MASS CLASS COMBINATION, 1 CARD OF THE FOLLOWING FORMAT

CONTAINS VULNERABLE AREAS FOR NET STRIKING SPEED=0.0, 0.1, 0.2, . . . ,>1.0 VNETHI

VUL(I,1,K)	VUL(I,2,K)	VUL(I,3,K)	VUL(I,4,K)	VUL(I,5,K)	VUL(I,6,K)	VUL(I,7,K)	VUL(I,8,K)	VUL(I,9,K)	VUL(I,10,K)	VUL(I,11,K)

STATIC FRAGMENT DENSITY (3 CARDS) FRAGMENTS/STERADIAN AT 0°, 10°, 20° . . . ,180° OFF MISSILE NOSE

STEAR(1)	STEAR(2)	STEAR(3)	STEAR(4)	STEAR(5)	STEAR(6)	STEAR(7)	STEAR(8)
STEAR(9)	STEAR(10)	STEAR(11)	STEAR(12)	STEAR(13)	STEAR(14)	STEAR(15)	STEAR(16)
STEAR(17)	STEAR(18)	STEAR(19)					

FRACTION BY NUMBER OF ALL FRAGMENTS BELONGING TO EACH MASS CLASS AND AVERAGE WEIGHT IN GRAINS (NWTS CARDS)

FRACT(I)	WATE(I)

FIGURE 2-1 (continued)

FUZE CONSTANTS (1 CARD)

Columns 1–10	Columns 11–20	Columns 21–30	Columns 31–40	Columns 41–50	Columns 51–60
HAFANG	RMAX	DTRF	PDRF	DTCF	PDCF

MISCELLANEOUS CONSTANTS (1 CARD)

Columns 1–10	Columns 11–20	Columns 21–30	Columns 31–40
VNETHI	RMISS	CDR	VE

FIGURE 2-1 (continued)

is arbitrary; however, the user will probably wish the point to correspond to some natural feature of the aircraft (e.g., nose, center of gravity, pilot).

2.1 Control Parameters

The control parameters are read in on the first card and define the number of cards to follow. These nine parameters are read in as FORTRAN integer variables. That is, the numbers must be right-justified and no decimal points may appear. The definitions of each of the parameters appear in Section 5.

The control parameters are limited by the following constraints:

$$1 \le \text{NCOMPS} \le 25^*$$
$$0 \le \text{NDUBLY} \le [\text{NCOMPS}/2]$$
$$0 \le \text{NSHLDS} \le 25$$
$$0 \le \text{NBLAST} \le 25$$
$$0 \le \text{NDHNK} \le 25$$
$$0 \le \text{NDHK} \le \text{NDHNK}$$
$$1 \le \text{NGLIT} \le 25$$
$$1 \le \text{NLEVS} \le 4^*$$
$$1 \le \text{NWTS} \le 10^*$$

where the symbol [] is read "the greatest integer less than or equal to."

2.2 Vulnerable Component Locations

Vulnerable component locations are read in, one to a card, with the units to be feet. There must be at least one vulner-

---

* These limits are based on the assumption of being able to utilize 300K (octal) of computer core. If less core is available, one or more of these numbers must be reduced (see discussion of vulnerable area inputs).

able component. If the control parameter NDUBLY is greater than zero, then the first NDUBLY pairs of vulnerable components are assumed to be doubly vulnerable.

2.3 Ellipsoids

There are four sets of ellipsoid centroids and semi-axes. The units are to be feet. Each card contains the coordinates of one centroid and the corresponding semi-axes. Any of these sets may be omitted if the corresponding control parameter is zero. If there are no direct-hit-no-kill-ellipsoids, then there can be no direct-hit-with-kill-ellipsoids.

2.4 Glitter Point Locations

Glitter point locations are read in, one to a card, with the units to be feet. At least one glitter point must be present.

2.5 Vulnerable Area Tables

The vulnerable area tables are the most extensive and complicated set of inputs. The nesting of these cards is shown on the second page of Figure 2-1. The outermost level of nesting is by kill level. All cards for each kill level are grouped together. The second level of nesting is by vulnerable component. Within a particular kill level all cards for each vulnerable component are grouped together. The third level of nesting is by aspect. For any component at a particular kill level the cards for each aspect are grouped together. The aspects are in the order: bottom, top, left, right, front, rear. The innermost level of nesting is by fragment mass class. Thus,

for a particular aspect of a particular vulnerable component at a particular kill level, there must be one vulnerable area input card for each fragment mass class. Each individual card contains 11 vulnerable areas, one for each value of striking speed from 0.0, 0.1, 0.2,..., $\geq$1.0·VNETHI. The units are square feet.

The vulnerable area data is read into the FORTRAN array VUL(I,J,K). The subscript I denotes kill level. The subscript J denotes striking speed. The subscript K is a composite combining aspect, component and fragment mass class. The formula for computing K is:

K = NWTS·(6·component number +aspect number-7)+mass class number.

The array VUL requires core storage of 66·NCOMPS·NWTS·NLEVS words. Thus, to accommodate 25 components, 4 kill levels and 10 mass classes requires 66,000 words for VUL alone and thus demands the full 98,304 word capacity of the CDC 6600 computer system at NADC. Since it requires a special arrangement to be allowed to use this much core, it is normally desirable to restrict the number of components, kill levels and/or mass classes in order to reduce the storage requirements of VUL. For example, the listing of the DSAMAM program in Section 4 is for a case limited to 12 components, 1 mass class, and 2 kill levels. Thus, VUL requires only 1,584 words and the program can be run using less than 40,000 words of core.

2.6 Fragment Densities

The static explosion fragment density data is read in from three cards. The densities are in fragments per steradian. There are values read in for angles of 0°, 10°, $20^{\circ}, \ldots, 180^{\circ}$ for a total of 19 entries (8 on each of the first two cards and three on the third).

2.7 Fragment Mass Classes

The fraction by number of all fragments belonging to each mass class and the average weight of each class are read in from NWTS cards. Each card contains the average weight in grains of the fragments in one class and the fraction by number of all fragments in that class.

2.8 Fuze Parameters

There is one card used to read in various constants for the radar and contact fuzes. This card contains the half-angle of the cone of the radar fuze, the maximum range of the radar fuze, the delay time of the radar fuze, the dud probability for the radar fuze, the delay time of the contact fuze, and the dud probability of the contact fuze.

2.9 Miscellaneous Constants

Finally, four miscellaneous constants are read in on one data card. These are the normalizing value for the striking speed argument in the vulnerable area tables, the range at which a miss is assumed given that the point of closest approach has been passed, the fragment drag coefficient, and the static emission speed of the fragments.

SECTION 3

NEW DSAMAM OUTPUT

The following pages of this section show those portions of the DSAMAM output which differ from the basic DSAMAM output due to the endgame addition.

There are two types of new output which appear. The first is simply a listing of the new input data. This listing is complete except for the omission of the vulnerable area tables. The second output type is the "summary of kill" which appears at the time of missile detonation. The summary includes:

1. Time of detonation due to radar fuze.
2. Range from missile to target at detonation.
3. Inertial coordinates of missile and target at detonation.
4. Coordinates of missile in aircraft body system.
5. Coordinates of aircraft in missile body system.
6. Probabilities of each component having survived this single missile at all kill levels.
7. Probabilities of each component having survived all missiles up to and including this one at all kill levels.
8. Probabilities of the aircraft having been killed by this single missile at all kill levels.
9. Probabilities of the aircraft having been killed by all missiles up to and including this one at all kill levels.

```
*       TEST CASE
*               DEMONSTRATE AIR CRAFT TRAJ GENERATION
*               AND NEW MISSILE GUIDANCE MODE

ST FLGHT        THIS IS REGULAR TITLE-SAMPLE RUN


INPUT DATA
TSTART =    0.00    TCTAL =     60.00   HP=  .0625  DTPO =  2.00
    IGUIDE =  2   IAC =   1   IPLOT =  0   DPLOT =    1.00
    IACIN =  0   IACOUT =  1   IEDIT =  0   ISTOR =  1
    IMODE =  1



NUMBER OF COMPONENTS                           = 12
NUMBER OF DOUBLY VULNERABLE PAIRS              =  0
NUMBER OF SHIELDING ELLIPSOIDS                 =  0
NUMBER OF BLAST ELLIPSOIDS                     =  1
NUMBER OF DIRECT-HIT-NO-KILL ELLIPSOIDS        =  8
NUMBER OF DIRECT-HIT-WITH-KILL ELLIPSOIDS      =  8
NUMBER OF GLITTER POINTS                       = 23
NUMBER OF KILL LEVELS                          =  2
NUMBER OF FRAGMENT WEIGHT CLASSES              =  1
```

COMPONENT LOCATIONS

	X	Y	Z
1	-4.70	0.00	4.70
2	-34.10	0.00	1.80
3	-29.30	0.00	1.40
4	-17.90	1.90	3.50
5	-17.90	-1.90	3.50
6	-23.50	1.90	3.60
7	-23.50	-1.90	3.60
8	-28.20	0.00	3.10
9	-23.20	4.60	5.60
10	-23.20	-4.60	5.60
11	-35.30	0.00	3.70
12	-32.30	0.00	3.70

BLAST ELLIPSOIDS
CENTROIDS AND SEMI-AXES

	X	Y	Z	A	B	C
1	-23.40	0.00	5.00	35.64	40.09	35.64

DIRECT-HIT-NO-KILL ELLIPSOIDS
CENTROIDS AND SEMI-AXES

	X	Y	Z	A	B	C
1	-23.10	0.00	5.00	23.10	3.00	4.00
2	-41.60	0.00	11.10	3.80	.20	3.80
3	-44.40	0.00	15.30	2.80	.13	2.80
4	-25.50	6.80	5.40	4.70	4.70	.50
5	-25.50	-6.80	5.40	4.70	4.70	.50
6	-29.30	15.30	5.40	4.00	4.00	.30
7	-29.30	-15.30	5.40	4.00	4.00	.30
8	-40.80	0.00	3.30	4.30	8.33	.20

DIRECT-HIT-WITH-KILL ELLIPSOIDS
CENTROIDS AND SEMI-AXES

	X	Y	Z	A	B	C
1	-23.10	0.00	5.00	23.10	3.00	4.00
2	-41.60	0.00	11.10	3.80	.20	3.80
3	-44.40	0.00	15.30	2.80	.13	2.80
4	-25.50	6.80	5.40	4.70	4.70	.50
5	-25.50	-6.80	5.40	4.70	4.70	.50
6	-29.30	15.30	5.40	4.00	4.00	.30
7	-29.30	-15.30	5.40	4.00	4.00	.30
8	-40.80	0.00	3.30	4.30	8.33	.20

GLITTER POINT LOCATIONS

	X	Y	Z
1	-3.33	1.70	2.50
2	-3.33	-1.70	2.50
3	-45.00	0.00	6.90
4	-31.50	19.60	7.60
5	-31.50	-19.60	7.60
6	-15.90	2.33	7.20
7	-15.90	-2.33	7.20
8	-30.10	2.20	7.60
9	-30.10	-2.20	7.60
10	-32.80	0.00	9.70
11	-44.20	0.00	7.50
12	-43.40	0.00	18.00
13	-40.50	6.83	6.20
14	-40.50	-6.83	6.20
15	-36.30	2.33	5.30
16	-36.30	-2.33	5.30
17	-43.70	2.00	5.30
18	-43.70	-2.00	5.30
19	-3.20	0.00	6.50
20	-10.60	0.00	8.60
21	-.83	0.00	5.00
22	-19.00	0.00	1.60
23	-32.80	0.00	2.10

STATIC FRAGMENT DENSITY BY 10 DEGREE INTERVALS

0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0.	0.	0.	0.	0.	0.	0.	0.	1244.	1228.	1244.	0.	0.	0.	0.	0.	0.	0.	0.

FRAGMENT DISTRIBUTION BY WEIGHT

AVERAGE WEIGHT IN GRAINS	FRACTION OF ALL FRAGMENTS
145.0	1.00

```
HALF-ANGLE OF RADAR FUZE                                =  72.0 DEGREES
MAXIMUM RANGE OF RADAR FUZE                             = 200. FEET
DELAY TIME OF RADAR FUZE                                = 0.000 SECONDS
DUD PROBABILITY OF RADAR FUZE                           = 0.000
DELAY TIME OF CONTACT FUZE                              = 0.000 SECONDS
DUD PROBABILITY OF CONTACT FUZE                         = 0.000
NORMALIZING SPEED FOR VULNERABLE AREA TABLE             =  5000. FPS.
MISS ASSUMED AFTER FAILURE TO FUZE WHEN RANGE           = 800. FEET
FRAGMENT DRAG COEFFICIENT                               =  .01200
FRAGMENT EMISSION SPEED                                 =  8200. FPS.
```

```
*****MISSILE TYPE 2*****

LIST OF EXTR

 J     EXTR(J)
 1   1.0000000E+03   NEVER BEGIN MANEUVER
24   5.0000000E+00   TIME BETWEEN MISSILES (SEC)
25   1.0000000E+03   NEVER FIRE SECOND SALVO
41   1.0000000E+05   MAXIMUM LAUNCH RANGE (FT)
42   0.              MINIMUM LAUNCH RANGE (FT)
43   5.0000000E+04   MAX ALTITUDE FOR LAUNCH (FT)
44   0.              MIN TARGET ALTITUDE (FT)
48   9.0000000E+01   MAX LAUNCH ELEVATION (DEG)
49   0.              MIN TARGET ELEVATION (DEG)
53   1.2000000E+04   GUIDANCE GAIN
54   1.5000000E+04   RANGE FROM MISSILE TO A/C BEGIN HOMING (FT)
55   6.0000000E+01   FRONT VULNERABLE AREA (SQ FT)
56   6.6000000E+02   REAR VUL AREA (SQ FT)
57   1.8000000E+02   SIDE VUL AREA (SQ FT)
58   6.0250000E+03   BOTTOM VUL AREA (SQ FT)
59   1.0000000E-03   TRACKING ERROR (RAD)
60   2.0000000E+01   ERROR FOR HOMING GUIDANCE (FT)

LIST OF IEXTR

 J  IEXTR(J)
11       3              = MISSILES IN SALVO
12       2              = SALVOS
13       1              DO NOT DETECT OR ACQUIRE
25      20              = MISSILES ALLOWED IN AIR
26       0              SUPPRESS ANGULAR RATE TEST
27       0              SUPPRESS SRP & CLOSING TEST

INITIAL AIRCRAFT STATE VECTOR
    POSITION   -2.5000000E+04   0.               5.0000000E+03
                2.5495100E+04   3.1415935E+00    1.9739956E-01
    VELOCITY    5.0000000E+02   0.               0.
                5.0000000E+02   0.               0.

ALTITUDE OF SAM SITE      0. FT.   STRUCTURE LIMIT 2.0 G"S   THROTTLE SETTING  .30
    NUMBER OF TIME LAGS  1      TIME LAGS IN SEC.     .100

*****F-4J IS A/C AERO TABLES*****
```

```
TIME=   0.000   A/C FLAGS-  1  1  1     SAMSITE FLAGS-  1  1  1

    AIRCRAFT VARIABLES

     RX            RY           RZ          RMAG        VX          VY          VZ       VMAG
  -25000.0          0.0       5000.0       25495.      500.          0.         0.0      500.0

    MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT        DRAG        CL      CD     CLMX
     .46       0.00       0.00          0.        .30          0.          0.     0.000  0.000  0.000

   ACOM    AOUTA    AOUTD     AOUT    VDOT
    0.0      0.0      0.0      0.0     0.0



*****MISSILE NO.  1 (BODY NO. 1) IS LAUNCHED AT TIME =    0.000

TIME=   0.000   A/C FLAGS-  1  1  1     SAMSITE FLAGS-  4  0  0

    AIRCRAFT VARIABLES

     RX            RY           RZ          RMAG        VX          VY          VZ       VMAG
  -25000.0          0.0       5000.0       25495.      500.          0.         0.0      500.0

    MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT        DRAG        CL      CD     CLMX
     .46       0.00       0.00          0.        .30          0.          0.     0.000  0.060  0.000

   ACOM    AOUTA    AOUTD     AOUT    VDOT
    0.0      0.0      0.0      0.0     0.0

     MISSILE OUTPUT
  NO.   X          Y          Z          VX         VY          VZ       VMAG   MACH   RREL     RDOT     LAMBDAE   LAMBDAA   DELE   DELA
   1     0.         0.         0.       -9.1        -.0         4.2      10.0   0.00  25495.     0.0       0.00      0.00   0.000  0.000
```

```
TIME=   2.000   A/C FLAGS-  2  1  1      SAMSITE FLAGS-  5  1  0

   AIRCRAFT VARIABLES       STRFLT

    RX            RY            RZ            RMAG          VX          VY          VZ        VMAG
 -23999.9          0.0        5000.0        24515.         500.         0.          0.0       500.1

   MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT       DRAG      CL     CD     CLMX
    .46       5.30       1.00        5493.        .30      40004.      5429.    .294   .040    .970

  ACOM    AOUTA    AOUTD    AOUT    VDOT
   0.0     0.0      0.0      0.0      .0

    MISSILE OUTPUT
 NO.    X         Y         Z        VX         VY        VZ       VMAG    MACH   RREL     RDOT     LAMBDAE   LAMBDAA   DELE    DELA
  1   -769.      -0.      259.    -797.0      -.0      237.2     831.5    .72   23710.   1318.3     0.00      0.00    0.000   0.000



TIME=   4.000   A/C FLAGS-  2  1  1      SAMSITE FLAGS-  5  1  0

   AIRCRAFT VARIABLES       STRFLT

    RX            RY            RZ            RMAG          VX          VY          VZ        VMAG
 -22999.7          0.0        5000.0        23537.         500.         0.          0.0       500.1

   MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT       DRAG      CL     CD     CLMX
    .46       5.30       1.00        5494.        .30      40004.      5429.    .294   .040    .970

  ACOM    AOUTA    AOUTD    AOUT    VDOT
   0.0     0.0      0.0      0.0      .0

    MISSILE OUTPUT
 NO.    X         Y         Z        VX         VY        VZ       VMAG    MACH   RREL     RDOT     LAMBDAE   LAMBDAA   DELE    DELA
  1   -3258.     -0.      917.    -1704.9     -.0      416.2    1755.0   1.55   20159.   2243.7     0.00      0.00    0.000   0.000
```

*****MISSILE NO. 2 (BODY NO. 2) IS LAUNCHED AT TIME = 5.000

TIME= 5.000 A/C FLAGS- 2 1 1 SAMSITE FLAGS- 4 1 0

AIRCRAFT VARIABLES STRFLT

RX	RY	RZ	RMAG	VX	VY	VZ	VMAG
-22499.6	0.0	5000.0	23048.	500.	0.	0.0	500.2

MACH	ALPHA	GFORCE	THRUST	THROTL	LIFT	DRAG	CL	CD	CLMX
.46	5.30	1.00	5494.	.30	40004.	5430.	.294	.040	.970

ACOM	AOUTA	AOUTD	AOUT	VDOT
0.0	0.0	0.0	0.0	.0

MISSILE OUTPUT

NO.	X	Y	Z	VX	VY	VZ	VMAG	MACH	RREL	RDOT	LAMBDAE	LAMBDAA	DELE	DELA
1	-5103.	-0.	1351.	-1882.1	-.0	426.7	1929.9	1.74	17775.	2419.2	0.00	0.00	0.000	0.000
2	0.	0.	0.	-9.0	-.0	4.4	10.0	0.00	23048.	0.0	0.00	0.00	0.000	0.000

TIME= 6.000 A/C FLAGS- 2 1 1 SAMSITE FLAGS- 5 2 0

AIRCRAFT VARIABLES STRFLT

RX	RY	RZ	RMAG	VX	VY	VZ	VMAG
-21999.4	0.0	5000.0	22560.	500.	0.	0.0	500.2

MACH	ALPHA	GFORCE	THRUST	THROTL	LIFT	DRAG	CL	CD	CLMX
.46	5.30	1.00	5494.	.30	40004.	5430.	.294	.040	.970

ACOM	AOUTA	AOUTD	AOUT	VDOT
0.0	0.0	0.0	0.0	.0

MISSILE OUTPUT

NO.	X	Y	Z	VX	VY	VZ	VMAG	MACH	RREL	RDOT	LAMBDAE	LAMBDAA	DELE	DELA
1	-6956.	-0.	1764.	-1903.3	-.0	399.2	1944.7	1.75	15349.	2433.6	0.00	0.00	0.000	0.000
2	-182.	-0.	75.	-374.8	-.0	140.3	400.4	.34	22366.	884.5	0.00	0.00	0.000	0.000

```
TIME=   8.000   A/C FLAGS-  2  1  1     SAMSITE FLAGS-  5  2  0

   AIRCRAFT VARIABLES       STRFLT

   RX          RY          RZ          RMAG       VX        VY        VZ       VMAG
 -20999.0      0.0       5000.0       21586.     500.       0.        0.0      500.3

  MACH     ALPHA     GFORCE     THRUST     THROTL     LIFT      DRAG      CL    CD    CLMX
   .46      5.33      1.00       5494.       .30     40094.     5430.    .294  .040  .970

  ACOM   AOUTA   AOUTB    AOUT    VDOT
   0.0    0.0     0.0      0.0     .0

    MISSILE OUTPUT
NO.    X           Y          Z        VX         VY        VZ      VMAG    MACH   RREL     RDOT     LAMBDAE  LAMBDAA   DELE    DELA
 1 -10843.        0.      2520.   -1940.0       .0      375.6   1976.0   1.78  10455.  2459.7    240.32      .00  -.641  -.000
 2  -1777.       -0.       578.   -1233.4      -.0      354.6   1283.3   1.13  19728.  1769.0      0.00     0.00  0.000  0.000



TIME=  10.000   A/C FLAGS-  2  1  1     SAMSITE FLAGS-  5  2  0

   AIRCRAFT VARIABLES       STRFLT

   RX          RY          RZ          RMAG       VX        VY        VZ       VMAG
 -19998.4      0.0       5000.0       20614.     500.       0.        0.0      500.3

  MACH     ALPHA     GFORCE     THRUST     THROTL     LIFT      DRAG      CL    CD    CLMX
   .46      5.29      1.00       5494.       .30     40004.     5431.    .294  .040  .970

  ACOM   AOUTA   AOUTD    AOUT    VDOT
   0.0    0.0     0.0      0.0     .0

    MISSILE OUTPUT
NO.    X           Y          Z        VX         VY        VZ      VMAG    MACH   RREL     RDOT     LAMBDAE  LAMBDAA   DELE    DELA
 1 -14741.        0.      3328.   -1952.5       .0      453.9   2004.6   1.82   5516.  2475.0    654.86      .00 -1.707  -.000
 2  -5968.       -0.      1451.   -1870.6      -.0      464.0   1927.3   1.73  15346.  2414.0      0.00     0.00  0.000  0.000
```

```
*****MISSILE NO.  3 (BODY NO. 3) IS LAUNCHED AT TIME =  10.000

TIME=  10.000   A/C FLAGS-  2  1  1     SAMSITE FLAGS-  4  2  0

   AIRCRAFT VARIABLES       STRFLT

   RX           RY            RZ           RMAG        VX         VY        VZ       VMAG
 -19998.4        0.0         5000.0        20614.      500.        0.        0.0      500.3

   MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT       DRAG       CL     CD     CLMX
    .46       5.29       1.06        5494.        .30      40004.      5431.      .294   .040   .970

  ACCM     AOUTA     AOUTD      AOUT     VDOT
   0.0      0.0       0.0        0.0       .0

    MISSILE OUTPUT
 NO.    X           Y        Z        VX          VY        VZ      VMAG    MACH    RREL     RDOT      LAMBDAE   LAMBDAA   DELE     DELA
  1 -14741.        0.     3328.   -1952.5        .0      453.9    2004.6   1.82    5516.   2475.0     654.86       .00  -1.707   -.000
  2  -5068.       -0.     1451.   -1870.6       -.0      464.0    1927.3   1.73   15346.   2414.0       0.00      0.00   0.000   0.000
  3      0.        0.        0.      -8.9       -.0        4.6      10.0   0.00   20614.      0.0       0.00      0.00   0.000   0.000



LAST MISSILE IN SALVO FIRED AT TIME =  10.000



TIME=  12.000   A/C FLAGS-  2  1  1     SAMSITE FLAGS-  6  3  0

   AIRCRAFT VARIABLES       STRFLT

   RX           RY            RZ           RMAG        VX         VY        VZ       VMAG
 -18997.7        0.0         5000.0        19645.      500.        0.        0.0      500.4

   MACH      ALPHA      GFORCE      THRUST      THROTL      LIFT       DRAG       CL     CD     CLMX
    .46       5.29       1.06        5494.        .30      40004.      5431.      .294   .040   .970

  ACCM     AOUTA     AOUTD      AOUT     VDOT
   0.0      0.0       0.0        0.0       .0

    MISSILE OUTPUT
 NO.    X           Y        Z        VX          VY        VZ      VMAG    MACH    RREL     RDOT      LAMBDAE   LAMBDAA   DELE     DELA
  1 -18525.        0.     4569.   -1675.1       -.0      935.8    1918.8   1.76     639.   2238.2   10846.87       .00-10.000   -.000
  2  -8852.       -0.     2325.   -1913.8       -.0      409.7    1957.2   1.77   19492.   2438.8     242.96      -.00   0.000   0.000
  3   -754.       -0.      291.    -783.2       -.0      271.7     829.0    .72   18841.   1310.7       0.00      0.00   0.000   0.000
```

SUMMARY OF KILL DUE TO MISSILE NO. 1

****MISSILE NO. 1 BURSTS DUE TO RADAR FUZE AT TIME= 12.270 AND RANGE= 191.0 FEET

STATE VECTORS IN INERTIAL COORDINATES AT BURST

	X	Y	Z	VX	VY	VZ
AIRCRAFT	-13862.	0.	5060.	500.4	0.0	0.0
MISSILE	-13963.	0.	4838.	-1547.5	-.0	1069.9

MISSILE IN A/C BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
-115.16	.00	-152.42	-52.93	180.00

A/C IN MISSILE BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
56.46	-.00	-182.50	72.61	.00

MISSILE STATUS AT BURST

OMEG	AM1	ANY	DEL	AB
3.724E-10	-7.430E+02	-5.528E+02	-1.000E+01	1.431E+01
7.855E-01	6.190E-07	-8.773E-08	-5.757E-09	2.092E-09
-3.282E-10	8.60E+02			

COMPONENT NUMBER	KILL LEVEL 1 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 1 CUMULATIVE SURVIVAL PROBABILITY	KILL LEVEL 2 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 2 CUMULATIVE SURVIVAL PROBABILITY
1	.996	.996	.989	.989
2	1.000	1.000	.999	.999
3	1.000	1.000	.955	.955
4	1.000	1.000	.950	.950
5	1.000	1.000	.950	.950
6	1.000	1.000	.967	.967
7	1.000	1.000	.967	.967
8	1.000	1.000	.903	.903
9	1.000	1.000	.966	.966
10	1.000	1.000	.966	.966
11	1.000	1.000	.996	.996
12	1.000	1.000	.994	.994

KILL LEVEL 1 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 1 AIRCRAFT CUMULATIVE KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT CUMULATIVE KILL PROBABILITY
.004	.004	.336	.336

TIME= 14.000 A/C FLAGS- 2 1 1 SAMSITE FLAGS- 6 3 0

AIRCRAFT VARIABLES STRFLT

RX	RY	RZ	RMAG	VX	VY	VZ	VMAG
-17996.8	0.0	5000.0	18679.	500.	0.	0.0	500.4

MACH	ALPHA	GFORCE	THRUST	THROTL	LIFT	DRAG	CL	CD	CLMX
.46	5.29	1.00	5494.	.30	40604.	5432.	.294	.040	.970

ACOM	AOUTA	AOUTD	AOUT	VDOT
0.0	0.0	0.0	0.0	.0

MISSILE OUTPUT

NO.	X	Y	Z	VX	VY	VZ	VMAG	MACH	RREL	RDOT	LAMBDAE	LAMBDAA	DELE	DELA
2	-12597.	0.	3199.	-1922.8	.0	490.4	1984.4	1.80	5598.	2452.2	656.01	.00	-1.819	-.000
3	-3265.	-0.	1059.	-1679.7	-.0	491.4	1750.1	1.55	15308.	2233.1	0.00	0.00	0.000	0.000

TIME= 16.000 A/C FLAGS- 2 1 1 SAMSITE FLAGS- 6 3 0

AIRCRAFT VARIABLES STRFLT

RX	RY	RZ	RMAG	VX	VY	VZ	VMAG
-16995.9	0.0	5000.0	17716.	501.	0.	0.0	500.5

MACH	ALPHA	GFORCE	THRUST	THROTL	LIFT	DRAG	CL	CD	CLMX
.46	5.29	1.00	5494.	.30	40304.	5432.	.294	.040	.970

ACOM	AOUTA	AOUTD	AOUT	VDOT
0.0	0.0	0.0	0.0	.0

MISSILE OUTPUT

NO.	X	Y	Z	VX	VY	VZ	VMAG	MACH	RREL	RDOT	LAMBDAE	LAMBDAA	DELE	DELA
2	-16416.	0.	4539.	-1648.9	-.0	955.4	1905.7	1.75	760.	2257.6	8289.33	.00	-10.000	-.000
3	-6888.	-0.	2071.	-1876.8	-.0	483.6	1938.1	1.75	10523.	2418.0	0.00	0.00	0.000	0.000

SUMMARY OF KILL DUE TO MISSILE NO. 2

****MISSILE NO. 2 BURSTS DUE TO RADAR FUZE AT TIME= 16.730 AND RANGE= 187.8 FEET

STATE VECTORS IN INERTIAL COORDINATES AT BURST

	X	Y	Z	VX	VY	VZ
AIRCRAFT	-16831.	0.	5000.	500.5	0.0	0.0
MISSILE	-16938.	0.	4845.	-1495.1	-.0	1106.4

MISSILE IN A/C BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
-120.46	.00	-144.10	-50.11	180.00

A/C IN MISSILE BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
55.20	-.00	-179.52	72.91	.00

MISSILE STATUS AT BURST

OMEG	AM1	ANY	DEL	AB
3.753E-10	-3.790E+02	-5.771E+02	-1.000E+01	1.519E+01
8.108E-01	5.796E-07	-8.150E-08	-5.615E-09	1.975E-09
-3.00E-10	8.84E+02			

COMPONENT NUMBER	KILL LEVEL 1 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 1 CUMULATIVE SURVIVAL PROBABILITY	KILL LEVEL 2 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 2 CUMULATIVE SURVIVAL PROBABILITY
1	.992	.988	.974	.963
2	1.000	1.000	.997	.996
3	1.000	1.000	.889	.849
4	1.000	1.000	.881	.837
5	1.000	1.000	.879	.835
6	1.000	1.000	.917	.887
7	1.000	1.000	.915	.885
8	1.000	1.000	.752	.679
9	1.000	1.000	.914	.883
10	1.000	1.000	.914	.883
11	1.000	1.000	.987	.983
12	1.000	1.000	.981	.975

KILL LEVEL 1 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 1 AIRCRAFT CUMULATIVE KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT CUMULATIVE KILL PROBABILITY
.008	.012	.658	.773

```
TIME=  18.000    A/C FLAGS-  2  1  1     SAMSITE FLAGS-  6  3  0

   AIRCRAFT VARIABLES        STRFLT

    RX           RY           RZ           RMAG         VX          VY          VZ        VMAG
 -15994.8          0.0      5000.0       16758.        501.          0.         0.0       500.6

   MACH       ALPHA      GFORCE      THRUST      THROTL      LIFT        DRAG        CL     CD      CLMX
    .46        5.29       1.00        5494.         .30      40005.      5432.      .294   .040    .970

  ACOM    AOUTA     AOUTD      AOUT      VDOT
   0.0      0.0       0.0       0.0        .0

     MISSILE OUTPUT
 NO.    X            Y           Z          VX           VY          VZ        VMAG     MACH     RREL     RDOT      LAMBDAE   LAMBDAA    DELE     DELA
  3 -10576.          0.       3021.     -1894.7          .0        519.1     1964.5    1.78     5675.   2425.9     716.02         .00 -1.950   -.000



TIME=  20.000    A/C FLAGS-  2  1  1     SAMSITE FLAGS-  6  3  0

   AIRCRAFT VARIABLES        STRFLT

    RX           RY           RZ           RMAG         VX          VY          VZ        VMAG
 -14993.6          0.0      5000.0       15805.        501.          0.         0.0       500.6

   MACH       ALPHA      GFORCE      THRUST      THROTL      LIFT        DRAG        CL     CD      CLMX
    .46        5.29       1.00        5494.         .30      40005.      5433.      .294   .040    .970

  ACOM    AOUTA     AOUTD      AOUT      VDOT
   0.0      0.0       0.0       0.0        .0

     MISSILE OUTPUT
 NO.    X            Y           Z          VX           VY          VZ        VMAG     MACH     RREL     RDOT      LAMBDAE   LAMBDAA    DELE     DELA
  3 -14316.          0.       4469.     -1597.8          .0        932.7     1881.1    1.72      900.   2234.1    7014.66         .00-10.000   -.000
```

SUMMARY OF KILL DUE TO MISSILE NO. 3

****MISSILE NO. 3 BURSTS DUE TO RADAR FUZE AT TIME= 20.402 AND RANGE= 209.2 FEET

STATE VECTORS IN INERTIAL COORDINATES AT BURST

	X	Y	Z	VX	VY	VZ
AIRCRAFT	-14792.	0.	5000.	500.6	0.0	0.0
MISSILE	-14926.	0.	4839.	-1416.4	-.0	1154.8

MISSILE IN A/C BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
-147.66	.00	-148.14	-45.09	180.00

A/C IN MISSILE BODY COORDINATES

X	Y	Z	ELEVATION	AZIMUTH
59.83	-.00	-209.43	73.38	.00

MISSILE STATUS AT BURST

OMEG	AM1	ANY	DEL	AB
2.956E-11	-7.669E+02	-6.408E+02	-1.000E+01	1.705E+01
6.832E-01	4.034E-07	-6.365E-08	-4.530E-09	1.523E-09
-2.00E-10	6.03E+02			

COMPONENT NUMBER	KILL LEVEL 1 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 1 CUMULATIVE SURVIVAL PROBABILITY	KILL LEVEL 2 SINGLE-SHOT SURVIVAL PROBABILITY	KILL LEVEL 2 CUMULATIVE SURVIVAL PROBABILITY
1	.989	.977	.966	.931
2	1.000	1.000	.996	.992
3	1.000	1.000	.837	.711
4	1.000	1.000	.836	.699
5	1.000	1.000	.834	.697
6	1.000	1.000	.881	.781
7	1.000	1.000	.880	.779
8	1.000	1.000	.642	.436
9	1.000	1.000	.881	.778
10	1.000	1.000	.881	.778
11	1.000	1.000	.879	.962
12	1.000	1.000	.970	.945

KILL LEVEL 1 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 1 AIRCRAFT CUMULATIVE KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT SINGLE-SHOT KILL PROBABILITY	KILL LEVEL 2 AIRCRAFT CUMULATIVE KILL PROBABILITY
.011	.023	.794	.953

SALVO NO. 1 COMPLETE AT TIME = 20.438
NEXT SALVO BEGINS AT TIME =1020.438

SECTION 4

PROGRAM LISTINGS

The following pages of this section are the FORTRAN program listings for those portions of the DSAMAM program which have been modified for the endgame. This includes the main program, subroutine MISSILE, and the following new subroutines:

- SPRAY
- STAB
- CONFUZE

```
PROGRAM DYNSAM     74/74    OPT=1                          FTN 4.6+420         77/08/04. 14.10.44         PAGE      1

      PROGRAM DYNSAM(INPUT,OUTPUT=/137,TAPE1,TAPE2,TAPE9,TAPE10,             SAM1       1
     1              TAPE5=INPUT,TAPE6=OUTPUT)                                SAM        3
      COMMON/DRIVE/TIME,HM,ISTART,TOTAL,EXTR(60),IEXTR(30),TITLE(18),        SAM        4
     1              DEG,G,PI,RAD                                             SAM        5
      COMMON/FLAGS/JPOL,KPOL,LPOL,JSAM,KSAM,LSAM,NMIN,ISTOP,IAC,IEDIT,       SAM        6
     1              IGUIDE,IMODE,MFLAG(20),JV                                SAM        7
      COMMON/AIRCF/FA(6),VA(6),ACOMA,ACOMD,ACOM,AOUTA,AOUTD,AOUT,VDOT,       SAM        8
     1              UNITV(3),A(3),D(3),UNITT(3),A1(3),D1(3),MACH,QA,         SAM        9
     2              ALPHA,LIFT,DRAG,GFORCE,UNITL(3),CL,CD,CLMX,SA,CA,        SAM       10
     3              THRUST,THROTL,ASMAX,ACTION,DASMX,DUMPL,DUMCL,ITAU,       SAM       11
     4              TAU(2),AUD(2,2)                                          SAM       12
      COMMON/ADATA/TBLTR(13,21),CDO(21),CDOCL2(21),MACHMX(13),ALPHAO(21) SAM       13
     1              ,DALDCL(21),CLMAX(21),AREA,WEIGHT                        SAM       14
      COMMON/MISSL/FM(6,20),VM(6,20),MACHM(20),QAM(20),SSA,AREAM,            SAM       15
     1              VV(2,20),DEL(2,20),AJ(2,20),MN(20),RAM(20),RAMD(20)      SAM       16
      COMMON/ACINC/X(3,481),BC(9,481),FUNIO(2),NPTS,NDUM1(6),DR(3)           SAM       17
      COMMON/PFINJ/IJ,IJX                                                    SAM       18
      COMMON /ONE/ NCOMPS,NLEVS,NHIS,NSHLDS,NBLAST,NGLIT,THA,RCHA,VE,        SAM1       2
     1DELT,XCM,YCM,ZCM,VNETNI,I                                              SAM1       3
      COMMON /TWO/ XGL(25),YGL(25),ZGL(25),YSH(25),YSH(25),ZSH(25),          SAM1       4
     1ASH(25),BSH(25),CSH(25),XBL(25),YBL(25),ZBL(25),ABL(25),BBL(25),       SAM1       5
     2CBL(25),XCMOLD(20),YCMOLD(20),ZCMOLD(20),EX(25),WY(25),ZEL(25),        SAM1       6
     3TAM(9),TMI(9)                                                          SAM1       7
      COMMON /THREE/ NDUBLY,NDHNK,NDHK,HAFANG,RMAX,DTRF,PDRF,DTCF,PDCF,      SAM1       8
     1RMISS,COF                                                              SAM1       9
      COMMON /FOUR/ XO(25,2),YO(25,2),ZO(25,2),XS(25,2),YS(25,2),            SAM1      10
     1ZS(25,2),WAIE(10)                                                      SAM1      11
      COMMON /FIVE/ VUL(2,11,72),STEAR(19),FRACT(10),SLOW(10)                SAM1      12
      COMMON /SIX/ CPS(4,25)                                                 SAM1      13
      DIMENSION THEC(19)                                                     SAM1      14
      REAL    LIFT,MACH,MACHM,MACHMX                                         SAM       19
      INTEGER     AFLAGS(6)                                                  SAM       20
      EQUIVALENCE (AFLAGS(1),JPOL)                                           SAM       21
      REAL    SVST(12),VPARM(3,20)                                           SAM       22
      REAL XAIR1(6),XAIR2(387)                                               SAM       23
      EQUIVALENCE (XAIR1(1),TBLTR(1,1)),   (XAIR2(1),TBLTR(7,1))             SAM       24
      INTEGER    JX(3),ICOORD(2)                                             SAM       25
      REAL    PARMNM(3,3),DNAME(6),ZWORD(4)                                  SAM       26
      INTEGER    IPARM(3),JPARM(3)                                           SAM       27
      LOGICAL    IMU(8)                                                      SAM       28
      EQUIVALENCE (JX(1),J1),(JX(2),J2),(JX(3),J3),(ZWORD(1),ACTION)         SAM       29
      DATA BLANK/1H /                                                        SAM       30
      DATA CO/1H*/                                                           SAM       31
      DATA END/4H+END/, ACNM/4H+END/                                         SAM       32
      NAMELIST/INPUT/TOTAL,HM,ISTART,DTPO,ICOORD,IGUIDE,IPRINT,IAC,          SAM       33
     1              IPLOT,DPLOT,IACIN,IACOUT,IEDIT,ISTOR,IMODE               SAM       34
C*****INITIALIZE CONSTANTS                                                   SAM       35
      DEG=57.29578                                                           SAM       36
      G=32.174                                                               SAM       37
      PI=ATAN2(0.0,-1.0)                                                     SAM1      15
      RAD=1.745329E-02                                                       SAM       39
      A(3)=0.                                                                SAM       40
C*****ZERO EXTRA VARIABLES                                                   SAM       41
```

```
      DO 50  J=1,30                                                     SAM      42
      EXTR(J)=0.                                                        SAM      43
      EXTR(J+30)=0.                                                     SAM      44
   50 IEXTR(J)=0                                                        SAM      45
C*****INITIALIZE NAMELIST FLAGS                                         SAM      46
      IPLOT=0                                                           SAM      47
      ISTART=0.                                                         SAM      48
      IACIN=0                                                           SAM      49
      ISTOR=0                                                           SAM      50
      IACOUT=0                                                          SAM      51
      IEDIT=0                                                           SAM      52
      IPRINT=1                                                          SAM      53
      IAC=1                                                             SAM      54
      IGUIDE=1                                                          SAM      55
      IMODE=1                                                           SAM      56
      ICOORD(1)=1                                                       SAM      57
      ICOORD(2)=1                                                       SAM      58
C*****READ NAMLIST, COMMENT, AND TITLE                                  SAM      59
  100 READ(5,INPUT)                                                     SAM      60
      IF(TOTAL.LT.0.) GO TO 1000                                        SAM      61
C*****SET STORAGE FLAG IF TRAJECTORY OUTPUT IS DESIRED                  SAM      62
      IF(IACOUT .GT. 0) ISTOR=1                                         SAM      63
      WRITE(6,600)                                                      SAM      64
  600 FORMAT(1H1)                                                       SAM      65
  101 READ(5,500) TITLE                                                 SAM      66
  500 FORMAT (18A4)                                                     SAM      67
      IF(TITLE(1) .NE. GO ) GO TO 103                                   SAM      68
      WRITE(6,601) TITLE                                                SAM      69
  601 FORMAT(1X,18A4)                                                   SAM      70
      GO TO 101                                                         SAM      71
  103 WRITE(6,602) TITLE                                                SAM      72
  602 FORMAT (1H0,18A4/)                                                SAM      73
      WRITE(6,603) ISTART,TOTAL,HM,DTPO,IGUIDE,IAC,IPLOT,DPLOT,IACIN,   SAM      74
     1             IACOUT,IEDIT,ISTOR,IMODE                             SAM      75
  603 FORMAT(11H0INPUT DATA/9H ISTART =,F7.2,10H    TOTAL =,F9.2,3X,    SAM      76
     1             3HHM=,F7.4,2X,6HDTPO =,F6.2/5X,8HIGUIDE =,I3,3X,     SAM      77
     2             5HIAC =,I3,3X,7HIPLOT =,I3,3X,7HDPLOT =,F7.2,/5X,    SAM      78
     3             7HIACIN =,I3,3X,8HIACOUT =,I3,3X,7HIEDIT =,I3,3X,    SAM      79
     4             7HISTOR =,I3/5X,7HIMODE =,I3)                        SAM      80
C*****READ CONTROL PARAMETERS                                           SAM1     16
      READ(5,2000)NCOMPS,NDOUBLY,NSHLDS,NBLAST,NDHNK,NDHK,NGLIT,NLEVS,  SAM1     17
     1NWTS                                                              SAM1     18
 2000 FORMAT(9(3X,I2))                                                  SAM1     19
       WRITE(6,3000)NCOMPS,NDOUBLY,NSHLDS,NBLAST,NDHNK,NDHK,NGLIT,NLEVS, SAM1    20
     1NWTS                                                              SAM1     21
 3000 FORMAT(////" NUMBER OF COMPONENTS",22X,"=",I3/                    SAM1     22
     1" NUMBER OF DOUBLY VULNERABLE PAIRS",9X,"=",I3/                   SAM1     23
     2" NUMBER OF SHIELDING ELLIPSOIDS",12X,"=",I3/                     SAM1     24
     3" NUMBER OF BLAST ELLIPSOIDS",16X,"=",I3/                         SAM1     25
     4" NUMBER OF DIRECT-HIT-NO-KILL ELLIPSOIDS    =",I3/               SAM1     26
     5" NUMBER OF DIRECT-HIT-WITH-KILL ELLIPSOIDS =",I3/                SAM1     27
     6" NUMBER OF GLITTER POINTS",18X,"=",I3/                           SAM1     28
     7" NUMBER OF KILL LEVELS",21X,"=",I3/                              SAM1     29
```

```
     8" NUMBER OF FRAGMENT WEIGHT CLASSES",9X,"=",I3)
C*****READ COMPONENT LOCATIONS
      READ(5,2001)(EX(K),WY(K),ZEE(K),K=1,NCOMPS)
 2001 FORMAT(3F10.0)
      WRITE(6,3001)
 3001 FORMAT(//16X,"COMPONENT LOCATIONS")
      WRITE(6,3002)(K,EX(K),WY(K),ZEE(K),K=1,NCOMPS)
 3002 FORMAT(19X,"X",14X,"Y",14X,"Z"/5X,45("=")/(I5,3F15.2))
C*****READ SHIELD ELLIPSOID LOCATIONS AND SEMIAXES
      IF(NSHLDS.LT.1) GO TO 800
      READ(5,2002)(XSH(K),YSH(K),ZSH(K),ASH(K),BSH(K),CSH(K),K=1,NSHLDS)
 2002 FORMAT(6F10.0)
      WRITE(6,3003)
 3003 FORMAT("1",33X,"FRAGMENT SHIELDING ELLIPSOIDS")
      WRITE(6,3004)(K,XSH(K),YSH(K),ZSH(K),ASH(K),BSH(K),CSH(K),
     1K=1,NSHLDS)
 3004 FORMAT(37X,"CENTROIDS AND SEMI-AXES"/19X,"X",14X,"Y",14X,"Z",16X,
     1"A",14X,"B",14X,"C"/5X,45("="),2X,45("=")/(I5,3F15.2,2X,3F15.2))
C*****READ BLAST ELLIPSOID LOCATIONS AND SEMIAXES
  800 IF(NBLAST.LT.1) GO TO 801
      READ(5,2002)(XBL(K),YBL(K),ZBL(K),ABL(K),BBL(K),CBL(K),K=1,NBLAST)
      WRITE(6,3005)
 3005 FORMAT("1",39X,"BLAST ELLIPSOIDS")
      WRITE(6,3004)(K,XBL(K),YBL(K),ZBL(K),ABL(K),BBL(K),CBL(K),
     1K=1,NBLAST)
C*****READ DIRECT-HIT-NO-KILL ELLIPSOID LOCATIONS AND SEMIAXES
  801 IF(NDHNK.LT.1) GO TO 802
      READ(5,2002)(XO(K,1),YO(K,1),ZO(K,1),XS(K,1),YS(K,1),ZS(K,1),
     1K=1,NDHNK)
      WRITE(6,3006)
 3006 FORMAT(//34X,"DIRECT-HIT-NO-KILL ELLIPSOIDS")
      WRITE(6,3004)(K,XO(K,1),YO(K,1),ZO(K,1),XS(K,1),YS(K,1),ZS(K,1),
     1K=1,NDHNK)
C*****READ DIRECT-HIT-WITH-KILL ELLIPSOID LOCATIONS AND SEMIAXES
      IF(NDHK.LT.1) GO TO 802
      READ(5,2002)(XO(K,2),YO(K,2),ZO(K,2),XS(K,2),YS(K,2),ZS(K,2),
     1K=1,NDHK)
      WRITE(6,3007)
 3007 FORMAT(//33X,"DIRECT-HIT-WITH-KILL ELLIPSOIDS")
      WRITE(6,3004)(K,XO(K,2),YO(K,2),ZO(K,2),XS(K,2),YS(K,2),ZS(K,2),
     1K=1,NDHK)
C*****READ GLITTER POINT LOCATIONS
  802 READ(5,2001)(XGL(K),YGL(K),ZGL(K),K=1,NGLIT)
      WRITE(6,3008)
 3008 FORMAT("1",13X,"GLITTER POINT LOCATIONS")
      WRITE(6,3002)(K,XGL(K),YGL(K),ZGL(K),K=1,NGLIT)
C*****READ VULNERABLE AREA TABLES
      KIND=6*NCOMPS*NWTS
      DO 803 LEV=1,NLEVS
      DO 803 K=1,KIND
  803 READ(5,2003)(VUL(LEV,J,K),J=1,11)
 2003 FORMAT(11F7.0)
C*****READ STATIC FRAGMENT DENSITY BY 10 DEGREE INTERVALS
```

```
      READ(5,2004)STEAR                                                 SAM1      83
 2004 FORMAT(8F10.0)                                                    SAM1      84
      DO 804 I=1,19                                                     SAM1      85
  804 IHED(I)=10*(I-1)                                                  SAM1      86
      WRITE(6,3009)IHED,STEAR                                           SAM1      87
 3009 FORMAT(//44X,"STATIC FRAGMENT DENSITY BY 10 DEGREE INTERVALS"/    SAM1      88
     1"0",19I7/1X,133("=")/1X,19F7.0)                                   SAM1      89
C*****READ FOR EACH MASS CLASS THE FRACTION OF ALL FRAGMENTS BELONGING  SAM1      90
C     TO THE CLASS AND THE AVERAGE MASS IN GRAINS                       SAM1      91
      READ(5,2005)(FRACT(KWT),WATE(KWT),KWT=1,NWTS)                     SAM1      92
 2005 FORMAT(2F10.0)                                                    SAM1      93
      WRITE(6,3010)(WATE(KWT),FRACT(KWT),KWT=1,NWTS)                    SAM1      94
 3010 FORMAT(//" FRAGMENT DISTRIBUTION BY WEIGHT"/                      SAM1      95
     1" AVERAGE WEIGHT    FRACTION OF"/                                 SAM1      96
     2"   IN GRAINS      ALL FRAGMENTS"/1X,32("=")/(F10.1,F17.2))       SAM1      97
C*****READ FUZE CONSTANTS                                               SAM1      98
      READ(5,2004)HAFANG,RMAX,DTRF,PDRF,DTCF,PDCF                       SAM1      99
      WRITE(6,3011)HAFANG,RMAX,DTRF,PDRF,DTCF,PDCF                      SAM1     100
 3011 FORMAT(//" HALF-ANGLE OF RADAR FUZE",22X,"=",F6.1," DEGREES"/     SAM1     101
     1" MAXIMUM RANGE OF RADAR FUZE",19X,"=",F5.0," FEET"/              SAM1     102
     2" DELAY TIME OF RADAR FUZE",22X,"=",F6.3," SECONDS"/              SAM1     103
     3" DUD PROBABILITY OF RADAR FUZE",17X,"=",F6.3/                    SAM1     104
     4" DELAY TIME OF CONTACT FUZE",20X,"=",F6.3," SECONDS"/            SAM1     105
     5" DUD PROBABILITY OF CONTACT FUZE",15X,"=",F6.3)                  SAM1     106
      HAFANG=HAFANG*RAD                                                 SAM1     107
C*****READ MISCELLANY                                                   SAM1     108
      READ(5,2004)VNETHI,RMISS,COR,VE                                   SAM1     109
      WRITE(6,3012)VNETHI,RMISS,COR,VE                                  SAM1     110
 3012 FORMAT(" NORMALIZING SPEED FOR VULNERABLE AREA TABLE    =",F7.0,  SAM1     111
     1" FPS."/                                                          SAM1     112
     2" MISS ASSUMED AFTER FAILURE TO FUZE WHEN RANGE =",F5.0," FEET"/  SAM1     113
     3" FRAGMENT DRAG COEFFICIENT",21X,"=",F8.5/                        SAM1     114
     5" FRAGMENT EMISSION SPEED",23X,"=",F7.0," FPS."/"1")              SAM1     115
C*****COMPUTE CONVENIENT CONSTANTS                                      SAM1     116
      THA=TAN(HAFANG)                                                   SAM1     117
      RCHA=RMAX*ABS(COS(HAFANG))                                        SAM1     118
C*****INITIALIZE CUMULATIVE COMPONENT SURVIVAL PROBABILITIES            SAM1     119
      DO 75 LEV=1,NLEVS                                                 SAM1     120
      DO 75 K=1,NCOMPS                                                  SAM1     121
   75 CPS(LEV,K)=1.0                                                    SAM1     122
C*****INITIALIZE MISSILE                                                SAM       81
      CALL MISINT(KDUM)                                                 SAM       82
C*****READ AND PRINT VARIABLE PARAMETERS                                SAM       83
      DO 105 I = 1, 3                                                   SAM       84
      NPARM=I-1                                                         SAM       85
      READ(5,503) ENDTST,JL,JPARM(I),(PARMNM(J,I),J=1,3),(VPARM(I,J),   SAM       86
     1               J=1,JL)                                            SAM       87
  503 FORMAT(A4,2I4,3A8,3E12.7/(6E12.7))                                SAM       88
C*****TEST FOR END OF VARIABLE PARAMETER DATA                           SAM       89
      IF(ENDTST .EQ. END) GO TO 106                                     SAM       90
      JPARM(I)=JL                                                       SAM       91
  105 WRITE(6,605)I,(PARMNM(J,I),J=1,3),JL,JPARM(I),(VPARM(I,J),J=1,JL) SAM       92
  605 FORMAT(9H0PARM NO.,I2,2X,3A8,5X,14HNO. OF VALUES=,I3,5X,          SAM       93
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     1              9HLOCATION=,I3/(5X,4E16.7))
      NPARM=3
C*****READ AND PRINT EXTR
  106 DO 107 J = 1, 60
      READ(5,505) ENDTST,K,Z,DNAME
  505 FORMAT(A4,I4,E12.7,6A8)
C*****TEST FOR END OF REAL EXTRA VARIABLE DATA
      IF(ENDTST .EQ. END) GO TO 108
C*****IF THERE IS EXTRA DATA WRITE PRINTOUT HEADER FIRST TIME ONLY
      IF(J .EQ. 1) WRITE(6,607)
  607 FORMAT(13HOLIST OF EXTR//14H  J     EXTR(J))
      EXTR(K)=Z
  107 WRITE(6,608) K,Z,DNAME
  608 FORMAT(I3,1X,1PE14.7,3X,6A8)
C*****READ AND PRINT IEXTR
  108 DO 109 J = 1, 30
      READ(5,508) ENDTST,K,IZ,DNAME
  508 FORMAT(A4,2I4,6A8)
C*****TEST FOR END OF INTEGER EXTRA VARIABLE DATA
      IF(ENDTST .EQ. END) GO TO 110
C*****IF THERE IS IEXTRA DATA WRITE PRINTOUT HEADER FIRST TIME ONLY
      IF(J .EQ. 1) WRITE(6,609)
  609 FORMAT(14HOLIST OF IEXTR//13H  J  IEXTR(J))
      IEXTR(K)=IZ
  109 WRITE(6,610) K,IZ,DNAME
  610 FORMAT(I3,I7,11X,6A8)
C*****TEST TO SEE IF A/C TRAJECTORY IS GENERATED
  110 IF(IAC .EQ. 2) GO TO 120
C*****READ AND PRINT STORED STATE VECTOR
      JA=3*ICOORD(1)-2
      JAA=JA+2
      JB=3*ICOORD(2)+4
      JBB=JB+2
      READ(5,510) (SVST(J),J=JA,JAA),(SVST(J),J=JB,JBB)
  510 FORMAT (6E12.6)
C*****CHANGE DEGREES TO RADIANS IF DATA IS IN SPHERICAL COORDINATES
      DO 113 I = 1,2
      IF(ICCORD(I) .EQ. 1) GO TO 113
      K1=6*I-1
      K2=K1+1
      DO 112 J = K1,K2
  112 SVST(J)=SVST(J)*RAD
  113 CONTINUE
      IF(NPARM.EQ.0) JPARM(1)=0
      DO 10 I=1,NPARM
      IF(JPARM(I).LT.0) GO TO 30
   10 CONTINUE
    5 CALL COORD(SVST(1),ICOORD(1))
      CALL COORD(SVST(7),ICOORD(2))
      WRITE (6,612)
  612 FORMAT (30HOINITIAL AIRCRAFT STATE VECTOR)
      WRITE(6,613)  SVST
  613 FORMAT(5X,9HPOSITION,1P3E15.6/17X,1P3E15.6/5X,9HVELOCITY,
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```
     1 1P3E15.6/13X,1P3E15.6)
       DO 20 I=1,NPARM
       IF(JPARM(I).GE.0) GO TO 20
       DO 15 K=1,12
    15 FA(K)=SVSI(K)
       GO TO 152
    20 CONTINUE
    30 READ(5,511) SSA,ASMAX,THROTS,ITAU,TAU
   511 FORMAT(3F6.0,I1,2F6.0)
       WRITE(6,615) SSA,ASMAX,THROTS,ITAU,(TAU(L),L=1,ITAU)
   615 FORMAT(21H0ALTITUDE OF SAM SITE,F7.0,4H FT.,2X,15HSTRUCTURE LIMIT,
     1        F4.1,4H G"S,2X,16HTHROTTLE SETTING,F5.2/5X,
     2      19HNUMBER OF TIME LAGS,I3,5X,17HTIME LAGS IN SEC.,2F8.3)
C*****TEST FOR READING OF A/C AERODYNAMIC DATA
       IF(IAC .EQ. 0) GO TO 115
       READ(5,512) XAIR1,ACNM,XAIR2
   512 FORMAT(6E12.5,A6/(6E12.5))
C*****TEST TO SEE IF A/C DATA IS PROPERLY LOADED AND IS NEEDED
   115 IF(ACNM .NE. END ) GO TO 117
C*****A/C DATA IS NOT LOADED WRITE MESSAGE + READ NEW DATA
       WRITE(6,620)
   620 FORMAT(51H0*****A/C AERODYNAMIC TABLES ARE NOT LOADED AND ARE,
     1           14H REQUIRED*****/15X,17HGOING TO NEXT RUN  )
       GO TO 100
C*****PRINT OUT TYPE OF A/C TABLES BEING USED
   117 WRITE(6,622) ACNM
   622 FORMAT(6H0*****,A4,24H IS A/C AERO TABLES*****)
       GO TO 125
C*****READ A/C TRAJECTORY DISPLACEMENT AND SAM ALTITUDE AND PRINT THEM
   120 READ(5,515) DR,SSA
   515 FORMAT(4F12.7)
       WRITE(6,625) DR,SSA
   625 FORMAT(46H0A/C TRAJECTORY IS READ IN AND IS DISPLACED BY/1P3E15.5/
     1          21H0ALTITUDE OF SAM SITE ,F7.0)
C*****READ A/C TRAJECTORY IF NEEDED
       IF(IACIN .GT. 0) READ(IACIN,700) RUNID,NPTS,
     1         ((X(IK,IL),IK=1,3),(BC(IK,IL),IK=1,9),IL=1,NPTS)
   700 FORMAT(2A4,I4/(6E13.6))
C*****PRINT TITLE OF NEW A/C DATA
       WRITE(6,627) IACIN,NPTS,RUNID
   627 FORMAT(42H0AIRCRAFT TRAJECTORY HAS BEEN READ ON UNIT,I3,5X,
     1          9HTHERE ARE ,I4,19H POINTS IN THE DATA/5X,
     2          16HTHE DATA ID IS    ,2A4)
C*****TEST FOR PARAMETER VARIATION
   125 IF(NPARM .GT. 0 ) GO TO 128
C*****WRITE TITLE FOR EDITOR IF NEEDED
       IF(IEDIT .LE. 0) GO TO 140
       WRITE(IEDIT,701) TITLE
   701 FORMAT(4H 1  ,18A4)
       JV=0
       GO TO 140
C*****INITIALIZE PARAMETER VARIATION
   128 IF(NPARM .EQ. 4 ) GO TO  130
```

```
      JS=NPARM+1                                                        SAM  200
      DO 129 J=JS,3                                                     SAM  201
  129 IPARM(J)=0                                                        SAM  202
  130 J1=0                                                              SAM  203
      J2=1                                                              SAM  204
      J3=1                                                              SAM  205
      JV=0                                                              SAM  206
      GO TO 136                                                         SAM  207
  135 IF(NPARM .EQ. 0) GO TO 365                                        SAM  208
  136 JV=JV+1                                                           SAM  209
C*****WRITE TITLE FOR RUN IF NEEDED                                     SAM  210
      IF(IEDIT .GT. 0) WRITE(IEDIT,702) JV,TITLE                        SAM  211
  702 FORMAT(2H 1,I2,18A4)                                              SAM  212
C*****INCREMENT PARAMETER INDICES                                       SAM  213
      J1=J1+1                                                           SAM  214
      IF(J1 .LE. IPARM(1)) GO TO 140                                    SAM  215
      J1=1                                                              SAM  216
      J2=J2+1                                                           SAM  217
      IF(J2 .LE. IPARM(2)) GO TO 140                                    SAM  218
      J2=1                                                              SAM  219
      J3=J3+1                                                           SAM  220
      IF(J3 .GT. IPARM(3)) GO TO 360                                    SAM  221
  140 CONTINUE                                                          SAM  222
C*****INITIALIZE MAIN DRIVE                                             SAM  223
      TPO=DTPO                                                          SAM  224
      TPLOT=0.0                                                         SAM  225
      ISTOP=0                                                           SAM  226
      KMIN=0                                                            SAM  227
C*****INITIALIZE FLAGS                                                  SAM  228
      DO 142 J=1,6                                                      SAM  229
      IMU(J)=.FALSE.                                                    SAM  230
  142 AFLAGS(J)=1                                                       SAM  231
      DO 143 J = 1, 20                                                  SAM  232
  143 MFLAG(J)=0                                                        SAM  233
      IPLOTL=0                                                          SAM  234
C*****BRANCH TO INITIALIZE A/C                                          SAM  235
      IF(IAC .EQ. 2) GO TO 147                                          SAM  236
C*****INITIALIZE A/C + MAIN DRIVE                                       SAM  237
      THROTL=THROTS                                                     SAM  238
      TIME=0.                                                           SAM  239
      IJ=1                                                              SAM  240
      IJX=0                                                             SAM  241
C*****LOAD STATES                                                       SAM  242
      DO 145 J=1,12                                                     SAM  243
  145 RA(J)=SVST(J)                                                     SAM  244
      GO TO 147                                                         SAM  245
C*****LOAD PARAMETERS IF NECESSARY                                      SAM  246
  147 IF ( NPARM .EQ. 0) GO TO 152                                      SAM  247
      WRITE(6,630)                                                      SAM  248
  630 FORMAT(19HILIST OF PARAMETERS)                                    SAM  249
      DO 150 J=1,NPARM                                                  SAM  250
      WRITE(6,632) (PARMNM(K,J),K=1,3),VPARM(J,JX(J))                   SAM  251
  632 FORMAT(1H0,3A8,5X,1PE15.6)                                        SAM  252
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          IF(JPARM(J) .LT. 0) GO TO 148                                     SAM      253
          EXTR(JPARM(J))=VPARM(J,JX(J))                                     SAM      254
          GO TO 150                                                         SAM      255
      148 IF(IAC .EQ. 2) GO TO 149                                          SAM      256
          GX=1.                                                             SAM      257
          IF(MOD(-(JPARM(J)+1),6).GE. 4) GX=RAD                             SAM      258
          FA(-JPARM(J))=VPARM(J,JX(J))*GX                                   SAM      259
          GO TO 150                                                         SAM      260
      149 DR(-JPARM(J))=VPARM(J,JX(J))                                      SAM      261
      150 CONTINUE                                                          SAM      262
          DO 40 I=1,12                                                      SAM      263
       40 SVSI(I)=FA(I)                                                     SAM      264
          DO 45 I=1,NPARM                                                   SAM      265
          IF(JPARM(I).LT.0) GO TO 5                                         SAM      266
       45 CONTINUE                                                          SAM      267
      152 CONTINUE                                                          SAM      268
C*****BRANCH AROUND A/C INIT IF TABLES ARE USED                              SAM      269
          IF(IAC .EQ. 2) GO TO 153                                          SAM      270
C*****INITIALIZE A/C AERODYNAMICS                                            SAM      271
          CALL INAERO                                                       SAM      272
C*****INITIALIZE A/C STABILITY COORDINATES                                   SAM      273
          CALL AD(VA)                                                       SAM      274
C*****INITIALIZE TRAJECTORY STORING POINTER, TIME, AND TITLE IF NEEDED      SAM      275
          IF(ISTOR .LE. 0) GO TO 153                                        SAM      276
          RUNID(1)=TITLE(1)                                                 SAM      277
          RUNID(2)=TITLE(2)                                                 SAM      278
          NPTS=0                                                            SAM      279
          TSTOR=TIME                                                        SAM      280
C*****BLANK OUT PRINT WORDS                                                  SAM      281
      153 DO 154 KK=1,4                                                     SAM      282
      154 ZWORD(KK)=BLANK                                                   SAM      283
C*****INITIALIZE TRAJECTORY INTERPOLATION IF NEEDED                          SAM      284
          IF(IAC .EQ. 2) CALL INTIN                                         SAM      285
          CALL OUTPUT                                                       SAM      286
          GO TO 310                                                         SAM      287
C*****MAIN DRIVE ITERATION                                                   SAM      288
      300 CALL SAMDOC                                                       SAM      289
C*****BRANCH TO CALL POLICY FOR A/C TRAJ. TO BE GENERATED                    SAM      290
C*****OR INTERPOLATION IF NOT                                                SAM      291
          IF(IAC .EQ. 2) GO TO 304                                          SAM      292
          CALL POLICY                                                       SAM      293
          GO TO 303                                                         SAM      294
      304 CALL INTAS                                                        SAM      295
      303 CONTINUE                                                          SAM      296
          IF ( NMIN .GT. 0) CALL MISSIL(KDUM)                               SAM      297
          TIME=TIME+HM                                                      SAM      298
C*****STORE A/C TRAJECTORY IF NEEDED                                         SAM      299
      310 IF(ISTOR .LE. 0 .OR. TIME .LT. TSTOR) GO TO 315                   SAM      300
C*****UPDATE POINTER AND TIME TO STORE                                       SAM      301
          NPTS=NPTS+1                                                       SAM      302
          TSTOR=TSTOR+.25                                                   SAM      303
          DO 311 J = 1, 3                                                   SAM      304
      311 X(J,NPTS)=FA(J)                                                   SAM      305
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      DO 312 J = 1, 3                                                   SAM  306
  312 HC(J,NPTS)=UNITI(J)                                               SAM  307
C*****TURN OFF STORAGE IF NO MORE ROOM                                  SAM  308
      IF(NPTS .EQ. 481) ISTOR=0                                         SAM  309
C*****WRITE DATA SET FOR PLOT IF DESIRED                                SAM  310
  315 IF(IPLOT.EQ. 0 .OR. TIME .LT. TPLOT) GO TO 322                    SAM  311
      TPLOT=TPLOT+DPLOT                                                 SAM  312
      IPLOTL=IPLOTL+1                                                   SAM  313
      DO 320 J=1,4                                                      SAM  314
      IF(MFLAG(J) .LE. 0 ) GO TO 318                                    SAM  315
      IMU(J)=.TRUE.                                                     SAM  316
      GO TO 320                                                         SAM  317
  318 RM(3,J)=-1.                                                       SAM  318
  320 CONTINUE                                                          SAM  319
      WRITE (10,501) (RA(J),J=1,3),((RM(J,K),J=1,3),K=1,4)              SAM  320
  501 FORMAT(1P8E10.3)                                                  SAM  321
  322 CONTINUE                                                          SAM  322
      IF(TIME .GE. TOTAL .OR. ISTOP .EQ. 1) GO TO 330                   SAM  323
      IF(TIME .LT. TPO) GO TO 300                                       SAM  324
      TPO=TIME+DTPO                                                     SAM  325
      CALL OUTPUT                                                       SAM  326
      GO TO 300                                                         SAM  327
C*****END OF ENCOUNTER                                                  SAM  328
  330 WRITE(6,640) IJ                                                   SAM  329
  640 FORMAT(I1,16HEND OF ENCOUNTER)                                    SAM  330
      IJ=0                                                              SAM  331
      CALL OUTPUT                                                       SAM  332
C*****WRITE OUT A/C TRAJECTORY IF NEED BE                               SAM  333
      IF(IACOUT .GT. 0) WRITE(IACOUT,700) RUNID,NPTS,                   SAM  334
     1              ((X(IK,IL),IK=1,3),(BC(IK,IL),IK=1,9),IL=1,NPTS)    SAM  335
C*****WRITE CONTROL DATA SET FOR PLOT IF NECESSARY                      SAM  336
      IF(IPLOT .EQ. 0 ) GO TO 135                                       SAM  337
      NVEH=1                                                            SAM  338
      DO 351 J=1,4                                                      SAM  339
      IF(IMU(J)) NVEH=NVEH+1                                            SAM  340
  351 CONTINUE                                                          SAM  341
      WRITE(9,705) TITLE,IPLOTL,NVEH,DPLOT                              SAM  342
  705 FORMAT(18A4/I3,I1,5HA1234,F6.2)                                   SAM  343
      GO TO 135                                                         SAM  344
C*****END OF TASK                                                       SAM  345
  360 WRITE (6,641)                                                     SAM  346
  641 FORMAT(15H0TASK COMPLETED)                                        SAM  347
      GO TO 100                                                         SAM  348
 1000 STOP                                                              SAM  349
      END                                                               SAM  350
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      SUBROUTINE MISSIL(KA)                                             SAM     904
      COMMON/DRIVE/TIME,HH,ISTART,TOTAL,EXTR(60),IEXTR(30),TITLE(18),   SAM     905
     1             DEG,G,PI,RAD                                         SAM     906
      COMMON/FLAGS/JPOL,KPOL,LPOL,JSAM,KSAM,LSAM,NMIN,ISTOP,IAC,IEDIT,  SAM     907
     1             IGUIDE,IMODE,MFLAG(20),JV                            SAM     908
      COMMON/AIRCF/RA(6),VA(6),ACOMA,ACOMD,ACOM,AOUTA,AOUTD,AOUT,VDOT,  SAM     909
     1             UNITV(3),A(3),D(3),UNITT(3),A1(3),D1(3),MACH,QA,     SAM     910
     2             ALPHA,LIFT,DRAG,GFORCE,UNITL(3),CL,CD,CLMX,SA,CA,    SAM     911
     3             THRUST,THROTL,ASMAX,ACTION,DASMX,DUMPL,DUMCL,ITAU,   SAM     912
     4             TAU(2),ADD(2,2)                                      SAM     913
      COMMON/ADATA/TBLTP(13,21),CDD(21),DCDCL2(21),MACHMX(13),ALPHAD(21) SAM     914
     1             ,DALDCL(21),CLMAX(21),AREA,WEIGHT                    SAM     915
      COMMON/MISSL/RM(6,20),VM(6,20),MACHM(20),QAM(20),SSA,AREAM,       SAM     916
     1             VV(2,20),DEL(2,20),AB(2,20),MN(20),RAM(20),RAMO(20)  SAM     917
      COMMON/PRINJ/IJ,IJX                                               SAM     918
      REAL    LIFT,MACH,MACHM,MACHMX                                    SAM     919
      REAL    ANU(2),LX1(2,2,20),LX2(2,2,20),LY1(2,2,20),LY2(2,2,20),   SAM     920
     1             TXX1(2),TXX2(2),RTT1(2),RTT2(2),AM1S(3,20),CC6(2,20), SAM     921
     2             CD1(2,20),CCX(2),CCY(2),CD2(2,20),CD3(2,20),DD(2),   SAM     922
     3             DDS(2,20),DE2(2,2,20),DD1(4),DD2(4,2),DE2(2),        SAM     923
     4             ANY(2,20),CNY(2),CNM(2),TL(20),V11(3,20),            SAM     924
     5             AM1(3),OMEG(3,20),X18(20),X19(20),SX19(20),CX19(20), SAM     925
     6             RX1(3),RX2(3),RX3(3),VX2(3),SZS(20),CZS(20),         SAM     926
     7             VMS(3,20),SPIS(20),TX1(2),TX2(2),OMES(3),TF(4)       SAM     927
      COMMON /ONE/ NCOMPS,NLEVS,NWTS,NSHLDS,NULAST,NGLIT,THA,RCHA,VE,   SAM1    123
     1DELT,XCM,YCM,ZCM,VNETHI,I                                         SAM1    124
      COMMON /TWO/ XGL(25),YGL(25),ZGL(25),XSH(25),YSH(25),ZSH(25),     SAM1    125
     1ASH(25),BSH(25),CSH(25),XBL(25),YBL(25),ZBL(25),ABL(25),BBL(25),  SAM1    126
     2CBL(25),XCMOLD(20),YCMOLD(20),ZCMOLD(20),EX(25),WY(25),ZEE(25),   SAM1    127
     3TAM(9),TMI(9)                                                     SAM1    128
      COMMON /THREE/ NDUBLY,NGHNK,NCHK,HAFANG,RMAX,DTRF,PORF,DTCF,PJGF, SAM1    129
     1RMISS,CDP                                                         SAM1    130
      COMMON /FOUR/ XO(25,2),YO(25,2),ZO(25,2),XS(25,2),YS(25,2),       SAM1    131
     1ZS(25,2),WATE(10)                                                 SAM1    132
      COMMON /FIVE/ VUL(2,11,72),STEAR(19),FRACT(10),SLOW(10)           SAM1    133
      COMMON /SIX/ CPS(4,25)                                            SAM1    134
      EQUIVALENCE (TIA(1),UNITT(1))                                     SAM1    135
      REAL TIA(9),PS(4,25),PSCF(4,25),PSRF(4,25),CPST(4,25),PKAC(4),    SAM1    136
     1CFKAC(4),KLEV(2,4),HEAD1(3),HEAD2(3),HEAD3(3),HEAD4(3),HEAD5(3),  SAM1    137
     2HEAD6(3)                                                          SAM1    138
      LOGICAL RAPFUZE                                                   SAM1    139
      EQUIVALENCE(CCX(1),CC1),(CCX(2),CC2),(CCY(1),CC7),(CCY(2),CC8)    SAM     928
      DATA KLEV,HEAD1,HEAD2,HEAD3,HEAD4/"KILL LEVEL"," 1","KILL LEVEL", SAM1    140
     1" 2","KILL LEVEL"," 3","KILL LEVEL"," 4","  SINGLE-S",            SAM1    141
     2"HOT       ","CUMULATIVE","    SURVIV","AL        "," SURVIVAL ", SAM1    142
     3"  PROBABIL","ITY       P","ROBABILITY","  ========","==========", SAM1    143
     4"=========="/                                                     SAM1    144
      DATA HEAD5,HEAD6/"    AIRCRA","FT        "," AIRCRAFT ",          SAM1    145
     1"     KILL","       ","     KILL    "/                            SAM1    146
      DATA TF      / 4.3, 7., 47.3, 60./                                SAM     929
      DATA    PI2 / 6.283186 /                                          SAM     930
      DATA    HMS /0.0/                                                 SAM     931
      RHO=RA(1)**2+RA(2)**2                                             SAM     932
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      SRR=SQRT(RHO)*RA(4)                                               SAM       933
      DD1(1)=(VA(3)*RHO-RA(3)*(RA(1)*VA(1)+RA(2)*VA(2)))/               SAM       934
     1(SRR*RA(4))                                                       SAM       935
      DD1(2)=(RA(1)*VA(2)-RA(2)*VA(1))/SRR                              SAM       936
      DD1(3)=RA(6)                                                      SAM       937
      DD1(4)=RA(5)                                                      SAM       938
      IF(KFILL .EQ. 0) GO TO 2                                          SAM       939
      DO 1 J = 1,2                                                      SAM       940
      DO 1 I = 1,4                                                      SAM       941
    1 DD2(I,J)=DD1(I)                                                   SAM       942
      KFILL=0                                                           SAM       943
      GO TO 4                                                           SAM       944
    2 DO 3 J = 1,2                                                      SAM       945
      DO 3 I = 1,4                                                      SAM       946
      DD1(I)=(DD2(I,J)-DD1(I))*TT1+DD1(I)                               SAM       947
    3 DD2(I,J)=DD1(I)                                                   SAM       948
    4 IF(IMODE .EQ. 2) GO TO 5                                          SAM       949
      DD3=(DD3-RA(4))*TT2+RA(4)                                         SAM       950
      DD3D=(DD3-DD3S)/HM                                                SAM       951
      DD3S=DD3                                                          SAM       952
    5 DO 1000  I=1,20                                                   SAM       953
      IF( MFLAG(I) .LE. 0 ) GO TO 1000                                  SAM       954
      TM=(TIME-TL(I))                                                   SAM       955
      IF(TM .LT. TF(MFLAG(I))) GO TO 6                                  SAM       956
      MFLAG(I)=MFLAG(I)+1                                               SAM       957
      IF (MFLAG(I) .LT. 5)  GO TO 6                                     SAM       958
      WRITE (6,2000) IJ,MN(I),TIME                                      SAM       959
 2000 FORMAT(I1,15H****MISSILE NO.,I3,25H SELF DESTRUCTS AT TIME =,F8.3) SAM       960
      IF(IEDIT .GT. 0) WRITE(IEDIT,5000) JV,(TITLE(J),J=1,2),I,MN(I),   SAM       961
     1              TIME,(RM(J,I),J=1,3),(RA(J),J=1,3)                  SAM       962
 5000 FORMAT(2H 2,I2,2A4,2H 4,2I2,7A4)                                  SAM       963
      IJX=IJ                                                            SAM       964
      IJ=0                                                              SAM       965
      CALL OUTPUT                                                       SAM       966
      MFLAG(I)=0                                                        SAM1      147
      NMIN=NMIN-1                                                       SAM1      148
      GO TO 1000                                                        SAM1      149
    6 IF (TM .LT. 6. ) GO TO 23                                         SAM       968
      IF(IGUIDE .EQ. 1) GO TO 806                                       SAM       969
      IF(RAM(I) .LE. EXTR(54) ) GO TO 822                               SAM       970
  806 IF (MFLAG(I) .LT. 3) GO TO 7                                      SAM       971
      SPO=RA(5)-RM(5,I)                                                 SAM       972
      IF(ABS(SPO) .GE. PI )  SPO=SPO-SIGN(PI2,SPO)                      SAM       973
      IF (ABS(SPO) .LE. .0871    .AND. ABS(RA(6)-RM(6,I)) .LE.          SAM       974
     1.0871) GO TO 7                                                    SAM       975
      WRITE(6,2001) IJ,MN(I),TIME                                       SAM       976
 2001 FORMAT(I1,15H****MISSILE NO.,I3,22H BREAKS LOCK AT TIME =,F8.3)   SAM       977
      IF(IEDIT .GT. 0) WRITE(IEDIT,5001) JV,(TITLE(J),J=1,2),I,MN(I),   SAM       978
     1              TIME,(RM(J,I),J=1,3),(RA(J),J=1,3)                  SAM       979
 5001 FORMAT(2H 2,I2,2A4,4H 3,2I2,7A4)                                  SAM       980
      IJX=IJ                                                            SAM       981
      IJ=0                                                              SAM       982
      CALL OUTPUT                                                       SAM       983
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      MFLAG(I)=0                                                      SAM1      150
      NMIN=NMIN-1                                                     SAM1      151
      GO TO 1000                                                      SAM1      152
    7 IF(TM .GT. 14. ) GO TO 8                                        SAM       985
      ZZ1=16400.                                                      SAM       986
      GO TO 10                                                        SAM       987
    8 IF(TM .GT. 55. ) GO TO 9                                        SAM       988
      ZZ1=2461.*TM-18054.                                             SAM       989
      GO TO 10                                                        SAM       990
    9 ZZ1=117301.                                                     SAM       991
   10 DO 12 J = 1,2                                                   SAM       992
      ANZ=RM(7-J,I)                                                   SAM       993
      DO 11 K = 1,2                                                   SAM       994
      DF2(J,K,I)=(DF2(J,K,I)-ANZ)*TT1+ANZ                             SAM       995
   11 ANZ=DF2(J,K,I)                                                  SAM       996
   12 DE2(J)=DF2(J,2,I)                                               SAM       997
      IF(IMODE .EQ. 2) GO TO  13                                      SAM       998
      ZZ2=(RM(1,I)*VM(1,I)+RM(2,I)*VM(2,I)+RM(3,I)*VM(3,I))/RM(4,I)   SAM       999
      ZZ3=DD3-RM(4,I)                                                 SAM      1000
      ZZ4=ZZ2-DD3C                                                    SAM      1001
      ZZ5=ZZ3*(1.-ZZ3/196200.)                                        SAM      1002
      ZZ6=ZZ4                                                         SAM      1003
      IF( ZZ6 .LT. 2295.) ZZ6=2295.                                   SAM      1004
      IF( ZZ6 .GT. 4920.) ZZ6=4920.                                   SAM      1005
      ZZ7=.5*ZZ5/ZZ6                                                  SAM      1006
      CC1=ZZ7*DD1(1)                                                  SAM      1007
      CC2=ZZ7*DD1(2)                                                  SAM      1008
      ZX=1310.+16.2*TM                                                SAM      1009
      GO TO 15                                                        SAM      1010
   13 CC1=0.                                                          SAM      1011
      CC2=0.                                                          SAM      1012
      IF (TM  .GE. 14.) GO TO 14                                      SAM      1013
      ZX=4920.+48.2*TM                                                SAM      1014
      GO TO 15                                                        SAM      1015
   14 ZX=12467.                                                       SAM      1016
   15 IF (RA(3) .GT. 3280. ) GO TO 19                                 SAM      1017
      CC5=0.                                                          SAM      1018
      CC3=0.                                                          SAM      1019
      IF (IMODE .EQ. 2) GO TO 16                                      SAM      1020
      CC1=ZZ1*(DD1(3)-DE2(1)+.1*ZZ7)                                  SAM      1021
      GO TO 20                                                        SAM      1022
   16 IF (TM .GT. 19.71) GO TO 17                                     SAM      1023
      F5V=75.44                                                       SAM      1024
      GO TO 18                                                        SAM      1025
   17 F5V=957.76*EXP(-.2*(TM-7.))                                     SAM      1026
   18 CC1=ZZ1*(DD1(3)-DE2(1))+F5V                                     SAM      1027
      GO TO 20                                                        SAM      1028
   19 CC1=ZZ1*(DD1(3)-DE2(1)+CC1)                                     SAM      1029
      CC3=ZX*DD1(1)                                                   SAM      1030
      CC5=100.*COS(DD1(3))                                            SAM      1031
   20 SPQ=DE1(4)-DE2(2)                                               SAM      1032
      CC2=ZZ1*(SPQ+CC2)                                               SAM      1033
      IF(ABS(SPQ) .GT. PI) SPQ=SPQ-SIGN(PI2,SPQ)                      SAM      1034
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          CC4=ZX*CD1(2)                                                   SAM    1035
          DO 21 J = 1,2                                                   SAM    1036
          X33=2.*(CCX(J)-CD1(J,I))/HM                                     SAM    1037
          CC6(J,I)=(CC6(J,I)-X33)*TT3+X33                                 SAM    1038
          CD1(J,I)=CCX(J)                                                 SAM    1039
          IF(ABS(CCX(J)).GT. 558.) CCX(J)=.166667*CCX(J)+SIGN(465.,CCX(J)) SAM   1040
       21 CONTINUE                                                        SAM    1041
          CC7=CC1+CC6(1,I)+CC3+CC5                                        SAM    1042
          CC8=CC2+CC6(2,I)+CC4                                            SAM    1043
          DO 22 J = 1,2                                                   SAM    1044
          CD2(J,I)=(CD2(J,I)-CCY(J))*TT4+CCY(J)                           SAM    1045
          VVS=VV(J,I)                                                     SAM    1046
          VV(J,I)=CD2(J,I)+1.2*(CD2(J,I)-CD3(J,I))/HM                     SAM    1047
          ANU(J)=(VV(J,I)-VVS)/HM                                         SAM    1048
       22 CD3(J,I)=CD2(J,I)                                               SAM    1049
          GO TO 23                                                        SAM    1050
      622 RRR2=RAM(I)**2                                                  SAM    1051
          OMES(1)=((RA(2)-RM(2,I))*(VA(3)-VM(3,I))-(RA(3)-RM(3,I))*       SAM    1052
         1                 (VA(2)-VM(2,I)))/RRR2                          SAM    1053
          OMES(2)=((RA(3)-RM(3,I))*(VA(1)-VM(1,I))-(RA(1)-RM(1,I))*       SAM    1054
         1                 (VA(3)-VM(3,I)))/RRR2                          SAM    1055
          OMES(3)=((RA(1)-RM(1,I))*(VA(2)-VM(2,I))-(RA(2)-RM(2,I))*       SAM    1056
         1                 (VA(1)-VM(1,I)))/RRR2                          SAM    1057
          CR=SQRT(VM(1,I)**2+VM(2,I)**2)                                  SAM    1058
          CX=-VM(3,I)/(VM(4,I)*CR)                                        SAM    1059
          VVS=VV(1,I)                                                     SAM    1060
          VV(1,I)=(OMES(1)*VM(2,I)-OMES(2)*VM(1,I))/CR*EXTR(53)           SAM    1061
          ANU(1)=(VV(1,I)-VVS)/HM                                         SAM    1062
          VVS=VV(2,I)                                                     SAM    1063
          VV(2,I)=(CX*(OMES(1)*VM(1,I)+OMES(2)*VM(2,I))+VM(4,I)/CR*OMES(3)) SAM  1064
         1                 *EXTR(53)                                      SAM    1065
          ANU(2)=(VV(2,I)-VVS)/HM                                         SAM    1066
       23 CALL ATMOS(I)                                                   SAM    1067
          MXZ=MFLAG(I)                                                    SAM    1068
          GO TO (24,25,25,26), MXZ                                        SAM    1069
       24 WM=4760.-281.*TM                                                SAM    1070
          TZ=60000.                                                       SAM    1071
          GO TO 27                                                        SAM    1072
       25 WM=2623.-26.4*TM                                                SAM    1073
          TZ=6000.                                                        SAM    1074
          GO TO 27                                                        SAM    1075
       26 WM=1376.                                                        SAM    1076
          TZ=0.0                                                          SAM    1077
       27 ZMS=WM/G                                                        SAM    1078
          IF(MXZ .EQ. 1) GO TO 46                                         SAM    1079
          IF (MXZ .EQ. 2) GO TO 48                                        SAM    1080
          Z11=MACHM(I)                                                    SAM    1081
          ZI=1./Z11**2                                                    SAM    1082
          SP2=-.578+.0122*TM                                              SAM    1083
          IF(Z11 .GT. 2.) GO TO 28                                        SAM    1084
          CF=-.356+1.093*Z11                                              SAM    1085
          CX1=-.256+.889*Z11                                              SAM    1086
          EX2=-.04585+.05335*Z11                                          SAM    1087
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      CX3=-.02+.135*Z11                                                 SAM       1088
      GO TO 29                                                          SAM       1089
   28 CF=-1.334+1.577*Z11                                               SAM       1090
      CX1=-.79+1.156*Z11                                                SAM       1091
      CX2=-.00515+.0329*Z11                                             SAM       1092
      CX3=.04+.085*Z11                                                  SAM       1093
   29 IF(TM .LE. 47.3) GO TO 31                                         SAM       1094
      SP2=0.0                                                           SAM       1095
      IF (Z11 .GT. 2.75) GO TO 30                                       SAM       1096
      CF=CF-.0475+.15*Z11                                               SAM       1097
      GO TO 31                                                          SAM       1098
   30 CF=CF+.207+.057*Z11                                               SAM       1099
   31 CF=CF*ZT+.75E-06*(SSA+RM(3,I))                                    SAM       1100
      IF(Z11 .GT. 1.6) GO TO 32                                         SAM       1101
      CY1=.601-.468*Z11                                                 SAM       1102
      GO TO 35                                                          SAM       1103
   32 IF(Z11 .GT. 2.25) GO TO 33                                        SAM       1104
      CY1=.316-.291*Z11                                                 SAM       1105
      GO TO 35                                                          SAM       1106
   33 IF(Z11 .GT. 2.75)  GO TO 34                                       SAM       1107
      CY1=-.34                                                          SAM       1108
      GO TO 35                                                          SAM       1109
   34 CY1=-6.92+.128*Z11                                                SAM       1110
   35 IF(Z11 .GT. 3.12) GO TO 36                                        SAM       1111
      CY2=-.0143-.05865*Z11                                             SAM       1112
      GO TO 37                                                          SAM       1113
   36 CY2=-.0805-.028*Z11                                               SAM       1114
   37 CY3=-5.*CX3                                                       SAM       1115
      SP3=QAM(I)/(1140.-3.6*TM)                                         SAM       1116
      IF (MFLAG(I) .GT.3) SP3=QAM(I)/370.                               SAM       1117
      IF(QAM(I) .LE. 3444.) GO TO 38                                    SAM       1118
      IF(QAM(I) .GE. 9030.) GO TO 39                                    SAM       1119
      SP1=10.55556-.0016582*QAM(I)                                      SAM       1120
      GO TO 40                                                          SAM       1121
   38 SP1=6.911                                                         SAM       1122
      GO TO 40                                                          SAM       1123
   39 SP1=1.                                                            SAM       1124
   40 SLOPE=(SP1-SP1S(I))/HM                                            SAM       1125
      IF(TM .LT. 7.05) SLOPE=-.625E-03                                  SAM       1126
      SP1S(I)=SP1                                                       SAM       1127
      DO 45  JDUM1 = 1, 8                                               SAM       1128
      SP4=SP1+SLOPE*GM*FLOAT(JDUM1-1)                                   SAM       1129
      DO 42 J = 1,2                                                     SAM       1130
      ANZ=ANY(J,I)                                                      SAM       1131
      ANUU=-VV(J,I)+FLOAT(8     -JDUM1)*ANU(J)*GM                       SAM       1132
      DO 41 K = 1,2                                                     SAM       1133
       LX1(J,K,I)=TX1(K)*LX1(J,K,I)+TXX1(K)*(LY1(J,K,I)-(ANUU-          SAM       1134
     1LY1(J,K,I))*FTT1(K))+ANUU-LY1(J,K,I)                              SAM       1135
      LY1(J,K,I)=ANUU                                                   SAM       1136
      ANUU=LX1(J,K,I)                                                   SAM       1137
      LX2(J,K,I)=TX2(K)*LX2(J,K,I)+TXX2(K)*(LY2(J,K,I)-(ANZ-LY2(J,K,I)) SAM       1138
     1*FTT2(K))+ANZ-LY2(J,K,I)                                          SAM       1139
      LY2(J,K,I)=ANZ                                                    SAM       1140
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   41 ANZ=LX2(J,K,I)                                                        SAM      1141
      DEL(J,I)=SP4*(.00517  *LX1(J,2,I)-.016    *LX2(J,2,I)+FLOAT(3-2*J)  SAM      1142
     1*OMEG(J+1,I)*4.16)                                                    SAM      1143
   42 IF(ABS(DEL(J,I)) .GT. 10.) DEL(J,I)=SIGN(10.,DEL(J,I))               SAM      1144
      CNY(1)=(AB(1,I)*(CX1+CX2*ABS(AB(2,I)))+CX3*DEL(1,I))*ZI             SAM      1145
      CNY(2)=(-AB(2,I)*(CX1+CX2*ABS(AB(1,I)))-CX3*DEL(2,I))*ZI            SAM      1146
      CNM(1)=(AB(1,I)*(CY1+CY2*ABS(AB(2,I)))+CY3*DEL(1,I))*ZI+SP2*CNY(1)  SAM      1147
      CNM(2)=(-AB(2,I)*(CY1+CY2*ABS(AB(1,I)))-CY3*DEL(2,I))*ZI+SP2*       SAM      1148
     1CNY(2)                                                                SAM      1149
      ANY(1,I)=-CAM(I)*CNY(1)/ZMS                                           SAM      1150
      ANY(2,I)=QAM(I)*CNY(2)/ZMS                                            SAM      1151
      AM1(1)=(TZ-CAM(I)*CF)/ZMS-G*SX19(I)-OMEG(2,I)*V11(3,I)+OMEG(3,I)*   SAM      1152
     1V11(2,I)                                                              SAM      1153
      AM1(2)=ANY(2,I)-OMEG(3,I)*V11(1,I)+OMEG(1,I)*V11(3,I)                SAM      1154
      AM1(3)=G*CX19(I)+ANY(1,I)-OMEG(1,I)*V11(2,I)+OMEG(2,I)*V11(1,I)      SAM      1155
      OD(1)=SP3*CNM(1)+.9825*OMEG(2,I)*OMEG(1,I)                           SAM      1156
      OD(2)=SP3*CNM(2)-.9825*OMEG(3,I)*OMEG(1,I)                           SAM      1157
      DO 43 J = 1,2                                                         SAM      1158
      OMEG(J+1,I)=OMEG(J+1,I)+.5*GM*(OD(J)+ODS(J,I))                       SAM      1159
   43 ODS(J,I)=OD(J)                                                        SAM      1160
      SPQ=OMEG(3,I)/CX19(I)                                                 SAM      1161
      OMEG(1,I)=-SPQ*SX19(I)                                                SAM      1162
      X18(I)=X18(I)+GM*SPQ                                                  SAM      1163
      X19(I)=X19(I)+GM*OMEG(2,I)                                            SAM      1164
      CX19(I)=COS(X19(I))                                                   SAM      1165
      SX19(I)=SIN(X19(I))                                                   SAM      1166
      DO 44 J= 1,3                                                          SAM      1167
      V11(J,I)=V11(J,I)+.5*GM*(AM1(J)+AMIS(J,I))                           SAM      1168
   44 AMIS(J,I)=AM1(J)                                                      SAM      1169
      AB(1,I)=ATAN(V11(3,I)/V11(1,I))*DEG                                   SAM      1170
   45 AB(2,I)=ATAN(V11(2,I)/V11(1,I))*DEG                                   SAM      1171
      IF((AB(1,I)**2+AB(2,I)**2) .LT. 900.) GO TO 9850                     SAM      1172
      WRITE(6,6005) IJ,MN(I),TIME                                           SAM      1173
 6005 FORMAT(I1,15H***MISSILE NO.,I3,24H GOES UNSTABLE AT TIME =,F8.3)     SAM      1174
      IF(IEDIT .GT. 0) WRITE(IEDIT,5004) JV,(TITLE(J),J=1,2),I,MN(I),      SAM      1175
     1               TIME,(RM(J,I),J=1,3),(RA(J),J=1,3)                    SAM      1176
 5004 FORMAT(2H 2,I2,2A4,2H 5,2I2,7A4)                                      SAM      1177
      IJX=IJ                                                                SAM      1178
      IJ=0                                                                  SAM      1179
      CALL OUTPUT                                                           SAM      1180
      MFLAG(I)=0                                                            SAM1      153
      MMIN=MMIN-1                                                           SAM1      154
      GO TO 1000                                                            SAM1      155
 9850 CONTINUE                                                              SAM      1182
      SZ=SIN(X18(I))                                                        SAM      1183
      CZ=COS(X18(I))                                                        SAM      1184
      VM(1,I)=CZ*(CX19(I)*V11(1,I)+SX19(I)*V11(3,I))-SZ*V11(2,I)          SAM      1185
      VM(2,I)=-SZ*(CX19(I)*V11(1,I)+SX19(I)*V11(3,I))-CZ*V11(2,I)         SAM      1186
      VM(3,I)=SX19(I)*V11(1,I)-CX19(I)*V11(3,I)                            SAM      1187
      GO TO 51                                                              SAM      1188
   46 IF(MACHM(I) .GT. .75 ) GO TO 47                                      SAM      1189
      CF=.24/MACHM(I)                                                       SAM      1190
      GO TO 50                                                              SAM      1191
```

```
   47 CF=(-1.2+1.84*MACHM(I))/MACHM(I)**2                              SAM      1192
      GO TO 50                                                         SAM      1193
   48 IF (MACHM(I) .GT. 2.) GO TO 49                                   SAM      1194
      CF= (-.366+1.093*MACHM(I))/MACHM(I)**2                           SAM      1195
      GO TO 50                                                         SAM      1196
   49 CF=(-1.334+1.577*MACHM(I))/MACHM(I)**2                           SAM      1197
   50 AM1(I)=(TZ-QAM(I)*CF)/ZMS-G*SX19(I)                              SAM      1198
      V11(1,I)=V11(1,I)+.5*HM*(AM1(I)+AM1S(1,I))                       SAM      1199
      AM1S(1,I)=AM1(I)                                                 SAM      1200
      OMEG(2,I)=-G*CX19(I)/V11(1,I)                                    SAM      1201
      IF (TM .LT. .19     ) OMEG(2,I)=0.                               SAM      1202
      X19(I)=X19(I)+HM*OMEG(2,I)                                       SAM      1203
      CX19(I)=COS(X19(I))                                              SAM      1204
      SX19(I)=SIN(X19(I))                                              SAM      1205
      VM(1,I)=CX19(I)*CZS(I)*V11(1,I)                                  SAM      1206
      VM(2,I)=-CX19(I)*SZS(I)*V11(1,I)                                 SAM      1207
      VM(3,I)=SX19(I)*V11(1,I)                                         SAM      1208
   51 CALL COORD(VM (1,I),1)                                           SAM      1209
      DO 52 J = 1,3                                                    SAM      1210
      RM(J,I)=RM(J,I)+HM*.5*(VM(J,I)+VMS(J,I))                         SAM      1211
   52 VMS(J,I)=VM(J,I)                                                 SAM      1212
      CALL COORD(RM(1,I),1)                                            SAM1      156
      XCG=RA(1)-RM(1,I)                                                SAM1      157
      YCG=RA(2)-RM(2,I)                                                SAM1      158
      ZCG=RA(3)-RM(3,I)                                                SAM1      159
      VX=VA(1)-VM(1,I)                                                 SAM1      160
      VY=VA(2)-VM(2,I)                                                 SAM1      161
      VZ=VA(3)-VM(3,I)                                                 SAM1      162
      XCM=-TIA(1)*XCG-TIA(2)*YCG-TIA(3)*ZCG                            SAM1      163
      YCM=-TIA(4)*XCG-TIA(5)*YCG-TIA(6)*ZCG                            SAM1      164
      ZCM=-TIA(7)*XCG-TIA(8)*YCG-TIA(9)*ZCG                            SAM1      165
      RAM(I)=SQRT(XCG**2+YCG**2+ZCG**2)                                SAM1      166
      RAMD(I)=-(XCG*VX+YCG*VY+ZCG*VZ)/RAM(I)                           SAM1      167
      IF(MFLAG(I).LE.2)GO TO 999                                       SAM1      168
      IF(MAFANG.NE.PI/2.0) GO TO 53                                    SAM1      169
      IF(RAMD(I).GT.0.0) GO TO 54                                      SAM1      170
      DEX=-RAMD(I)*RAM(I)/(VX**2+VY**2+VZ**2)                          SAM1      171
      DELT=1.0-DEX/HM                                                  SAM1      172
      GO TO 54                                                         SAM1      173
   53 TMI(1)=CZ*CX19(I)                                                SAM1      174
      TMI(2)=-SZ                                                       SAM1      175
      TMI(3)=CZ*SX19(I)                                                SAM1      176
      TMI(4)=-SZ*CX19(I)                                               SAM1      177
      TMI(5)=-CZ                                                       SAM1      178
      TMI(6)=-SZ*SX19(I)                                               SAM1      179
      TMI(7)=SX19(I)                                                   SAM1      180
      TMI(8)=0.0                                                       SAM1      181
      TMI(9)=-CX19(I)                                                  SAM1      182
      TAM(1)=TMI(1)*TIA(1)+TMI(4)*TIA(2)+TMI(7)*TIA(3)                 SAM1      183
      TAM(2)=TMI(1)*TIA(4)+TMI(4)*TIA(5)+TMI(7)*TIA(6)                 SAM1      184
      TAM(3)=TMI(1)*TIA(7)+TMI(4)*TIA(8)+TMI(7)*TIA(9)                 SAM1      185
      TAM(4)=TMI(2)*TIA(1)+TMI(5)*TIA(2)+TMI(8)*TIA(3)                 SAM1      186
      TAM(5)=TMI(2)*TIA(4)+TMI(5)*TIA(5)+TMI(8)*TIA(6)                 SAM1      187
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      TAM(6)=TMI(2)*TIA(7)+TMI(5)*TIA(8)+TMI(8)*TIA(9)                SAM1     188
      TAM(7)=TMI(3)*TIA(1)+TMI(6)*TIA(2)+TMI(9)*TIA(3)                SAM1     189
      TAM(8)=TMI(3)*TIA(4)+TMI(6)*TIA(5)+TMI(9)*TIA(6)                SAM1     190
      TAM(9)=TMI(3)*TIA(7)+TMI(6)*TIA(8)+TMI(9)*TIA(9)                SAM1     191
      CALL CONFUZE                                                    SAM1     192
   54 DO 100 KWT=1,NWTS                                               SAM1     193
  100 SLOW(KWT)=CDR*2.0*QA/(AREA*VA(4)**2*WATE(KWT)**(1.0/3.0))       SAM1     194
      IF(DELT.LE.1.0) GO TO 65                                        SAM1     195
      CALL STAB(XO,YO,ZO,XS,YS,ZS,NDHNK,T1)                           SAM1     196
      IF(T1.LE.1.0) GO TO 57                                          SAM1     197
      IF(RAND(I).GT.0.0) GO TO 999                                    SAM1     198
      IF(PAM(I).LT.RMISS) GO TO 999                                   SAM1     199
   55 DO 56 K=1,NCOMPS                                                SAM1     200
      DO 56 LEV=1,NLEVS                                               SAM1     201
   56 PS(LEV,K)=1.0                                                   SAM1     202
      RADFUZE=.FALSE.                                                 SAM1     203
      GO TO 83                                                        SAM1     204
   57 TBCF=T1+DTCF/HM                                                 SAM1     205
      CALL STAB(XO(1,2),YO(1,2),ZO(1,2),XS(1,2),YS(1,2),ZS(1,2),NDHK,T2) SAM1  206
      IF(T2.LE.1.0) GO TO 60                                          SAM1     207
   58 IF(PDCF.GE.1.0) GO TO 55                                        SAM1     208
      CALL SPRAY(TBCF,PSCF)                                           SAM1     209
      DO 59 K=1,NCOMPS                                                SAM1     210
      DO 59 LEV=1,NLEVS                                               SAM1     211
   59 PS(LEV,K)=PDCF+(1.0-PDCF)*PSCF(LEV,K)                           SAM1     212
      RADFUZE=.FALSE.                                                 SAM1     213
      GO TO 83                                                        SAM1     214
   60 IF(T2.GE.TBCF) GO TO 63                                         SAM1     215
   61 DO 62 K=1,NCOMPS                                                SAM1     216
      DO 62 LEV=1,NLEVS                                               SAM1     217
   62 PS(LEV,K)=0.0                                                   SAM1     218
      RADFUZE=.FALSE.                                                 SAM1     219
      GO TO 83                                                        SAM1     220
   63 IF(PDCF.GE.1.0) GO TO 61                                        SAM1     221
      CALL SPRAY(TBCF,PSCF)                                           SAM1     222
      DO 64 K=1,NCOMPS                                                SAM1     223
      DO 64 LEV=1,NLEVS                                               SAM1     224
   64 PS(LEV,K)=(1.0-PDCF)*PSCF(LEV,K)                                SAM1     225
      RADFUZE=.FALSE.                                                 SAM1     226
      GO TO 83                                                        SAM1     227
   65 TBRF=DELT+DTRF/HM                                               SAM1     228
      CALL STAB(XO,YO,ZO,XS,YS,ZS,NDHNK,T1)                           SAM1     229
      IF(T1.LE.1.0) GO TO 68                                          SAM1     230
      CALL SPRAY(TBRF,PSRF)                                           SAM1     231
   66 DO 67 K=1,NCOMPS                                                SAM1     232
      DO 67 LEV=1,NLEVS                                               SAM1     233
   67 PS(LEV,K)=PDRF+(1.0-PDRF)*PSRF(LEV,K)                           SAM1     234
      RADFUZE=.TRUE.                                                  SAM1     235
      GO TO 83                                                        SAM1     236
   68 TBCF=T1+DTCF/HM                                                 SAM1     237
      CALL STAB(XO(1,2),YO(1,2),ZO(1,2),XS(1,2),YS(1,2),ZS(1,2),NDHK,T2) SAM1  238
      IF(T2.LE.1.0) GO TO 74                                          SAM1     239
      IF(DELT.GE.T1) GO TO 58                                         SAM1     240
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      CALL SPRAY(TBRF,PSRF)                                          SAM1   241
      IF(PDCF.GE.1.0) GO TO 66                                       SAM1   242
      IF(TBRF.EQ.TBCF) GO TO 72                                      SAM1   243
      CALL SPRAY(TBCF,PSCF)                                          SAM1   244
      IF(TBRF.GT.TBCF) GO TO 70                                      SAM1   245
      DO 69 K=1,NCOMPS                                               SAM1   246
      DO 69 LEV=1,NLEVS                                              SAM1   247
   69 PS(LEV,K)=PDRF*PDCF+(1.0-PDRF)*PSRF(LEV,K)+PDRF*(1.0-PDCF)*    SAM1   248
     1PSCF(LEV,K)                                                    SAM1   249
      RADFUZE=.TRUE.                                                 SAM1   250
      GO TO 83                                                       SAM1   251
   70 DO 71 K=1,NCOMPS                                               SAM1   252
      DO 71 LEV=1,NLEVS                                              SAM1   253
   71 PS(LEV,K)=PDRF*PDCF+(1.0-PDCF)*PSCF(LEV,K)+PDCF*(1.0-PDRF)*    SAM1   254
     1PSRF(LEV,K)                                                    SAM1   255
      RADFUZE=.TRUE.                                                 SAM1   256
      GO TO 83                                                       SAM1   257
   72 DO 73 K=1,NCOMPS                                               SAM1   258
      DO 73 LEV=1,NLEVS                                              SAM1   259
   73 PS(LEV,K)=PDRF*PDCF+(1.0-PDRF*PDCF)*PSRF(LEV,K)                SAM1   260
      RADFUZE=.TRUE.                                                 SAM1   261
      GO TO 83                                                       SAM1   262
   74 IF(T2.GT.TBCF) GO TO 77                                        SAM1   263
      IF(T2.LE.TBRF) GO TO 61                                        SAM1   264
      CALL SPRAY(TBRF,PSRF)                                          SAM1   265
   75 DO 76 K=1,NCOMPS                                               SAM1   266
      DO 76 LEV=1,NLEVS                                              SAM1   267
   76 PS(LEV,K)=(1.0-PDRF)*PSRF(LEV,K)                               SAM1   268
      RADFUZE=.TRUE.                                                 SAM1   269
      GO TO 83                                                       SAM1   270
   77 IF(T2.LE.TBRF) GO TO 63                                        SAM1   271
      IF(DELT.GE.T1) GO TO 63                                        SAM1   272
      CALL SPRAY(TBRF,PSRF)                                          SAM1   273
      IF(PDCF.GE.1.0) GO TO 75                                       SAM1   274
      IF(TBRF.EQ.TBCF) GO TO 81                                      SAM1   275
      CALL SPRAY(TBCF,PSCF)                                          SAM1   276
      IF(TBRF.GT.TBCF) GO TO 79                                      SAM1   277
      DO 78 K=1,NCOMPS                                               SAM1   278
      DO 78 LEV=1,NLEVS                                              SAM1   279
   78 PS(LEV,K)=(1.0-PDRF)*PSRF(LEV,K)+PDRF*(1.0-PDCF)*PSCF(LEV,K)   SAM1   280
      RADFUZE=.TRUE.                                                 SAM1   281
      GO TO 83                                                       SAM1   282
   79 DO 80 K=1,NCOMPS                                               SAM1   283
      DO 80 LEV=1,NLEVS                                              SAM1   284
   80 PS(LEV,K)=(1.0-PDCF)*PSCF(LEV,K)+PDCF*(1.0-PDRF)*PSRF(LEV,K)   SAM1   285
      RADFUZE=.TRUE.                                                 SAM1   286
      GO TO 83                                                       SAM1   287
   81 DO 82 K=1,NCOMPS                                               SAM1   288
      DO 82 LEV=1,NLEVS                                              SAM1   289
   82 PS(LEV,K)=(1.0-PDCF*PDRF)*PSRF(LEV,K)                          SAM1   290
      RADFUZE=.TRUE.                                                 SAM1   291
   83 DEX=HM*(1.0-DELT)                                              SAM1   292
      TCM=TIME+HM-DEX                                                SAM1   293
```

```
      DO 84 J=1,3
      RX1(J)=RA(J)-DEX*VA(J)
      RX2(J)=RM(J,I)-DEX*VM(J,I)
   84 RX3(J)=RX2(J)-RX1(J)
      IF(IAC.EQ.2) CALL INBO
      CALL DOT(UNITT,RX3,X)
      CALL DOT(A1,RX3,Y)
      CALL DOT(B1,RX3,Z)
      XB0=SQRT(RX3(1)**2+RX3(2)**2+RX3(3)**2)
      XB1=ATAN2(Y,X)*DEG
      XB2=ASIN(Z/XB0)*DEG
      XX=-TMI(1)*RX3(1)-TMI(4)*RX3(2)-TMI(7)*RX3(3)
      YY=-TMI(2)*RX3(1)-TMI(5)*RX3(2)-TMI(8)*RX3(3)
      ZZ=-TMI(3)*RX3(1)-TMI(6)*RX3(2)-TMI(9)*RX3(3)
      XXB1=ATAN2(-YY,XX)*DEG
      XXB2=ASIN(-ZZ/XB0)*DEG
      WRITE(6,4000)MN(I)
 4000 FORMAT("1",10X,"SUMMARY OF KILL DUE TO MISSILE NO.",I3///)
      IF(RADFUZE) WRITE(6,2002)MN(I),TSM,XB0,RX1,(VA(J),J=1,3),RX2,
     1(VM(J,I),J=1,3),X,Y,Z,XB2,XB1,XX,YY,ZZ,XXB2,XXB1
 2002 FORMAT(" ****MISSILE NO.",I3," BURSTS DUE TO RADAR FUZE AT TIME=",
     1F8.3," AND RANGE=",F10.1," FEET"/
     2"0STATE VECTORS IN INERTIAL COORDINATES AT BURST"/13X,"X",
     39X,"Y",9X,"Z",9X,"VX",8X,"VY",8X,"VZ"/" AIRCRAFT",F8.0,
     42F10.0,3F10.1/" MISSILE",F9.0,2F10.0,3F10.1/
     5"0MISSILE IN A/C BODY COORDINATES"/6X,"X",8X,"Y",8X,"Z",
     65X,"ELEVATION    AZIMUTH"/3F9.2,F10.2,F12.2/
     7"0A/C IN MISSILE BODY COORDINATES"/6X,"X",8X,"Y",8X,"Z",
     85X,"ELEVATION    AZIMUTH"/3F9.2,F10.2,F12.2)
      IF(RADFUZE) WRITE(6,2003)(OMEG(J,I),AM1(J),ANY(J,I),DEL(J,I),
     1AB(J,I),J=1,2),OMEG(3,I),AM1(3)
 2003 FORMAT("0MISSILE STATUS AT BURST"/4X,"OMEG",9X,"AM1",9X,"ANY",
     19X,"DEL",9X,"AB"/2(1P5E12.3/),1P2E12.2)
      IJ=0
      IF(.NOT.RADFUZE) CALL OUTPUT
      WRITE(6,4001)((KLEV(J,LEV),J=1,2),LEV=1,NLEVS)
 4001 FORMAT("0  ",4(19X,A10,A2))
      WRITE(6,4002)((HEAD1(J),J=1,3),LEV=1,NLEVS)
 4002 FORMAT(10X,4(1X,3A10))
      WRITE(6,4003)((HEAD2(J),J=1,3),LEV=1,NLEVS)
 4003 FORMAT(" COMPONENT",4(1X,3A10))
      WRITE(6,4004)((HEAD3(J),J=1,3),LEV=1,NLEVS)
 4004 FORMAT("   NUMBER ",4(1X,3A10))
      WRITE(6,4005)((HEAD4(J),J=1,3),LEV=1,NLEVS)
 4005 FORMAT(" =========",4(1X,3A10))
      DO 86 K=1,NCOMPS
      DO 85 LEV=1,NLEVS
      CPS(LEV,K)=CPS(LEV,K)*PS(LEV,K)
   85 CPST(LEV,K)=CPS(LEV,K)
   86 WRITE(6,4006)K,(PS(LEV,K),CPS(LEV,K),LEV=1,NLEVS)
 4006 FORMAT(4X,I2,1X,4(F14.3,F17.3))
      IF(NDUBLY.LE.0) GO TO 88
      LNG=2*NDUBLY-1
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```
      DO 87 LEV=1,NLEVS                                                 SAM1     347
      DO 87 L=1,LEND                                                    SAM1     348
      PS(LEV,L)=PS(LEV,L)+PS(LEV,L+1)-PS(LEV,L)*PS(LEV,L+1)             SAM1     349
      PS(LEV,L+1)=1.0                                                   SAM1     350
      CPST(LEV,L)=CPST(LEV,L)+CPST(LEV,L+1)-CPST(LEV,L)*CPST(LEV,L+1)   SAM1     351
   87 CPST(LEV,L+1)=1.0                                                 SAM1     352
   88 DO 89 LEV=1,NLEVS                                                 SAM1     353
      PSAC=1.0                                                          SAM1     354
      CPSAC=1.0                                                         SAM1     355
      DO 89 K=1,NCOMPS                                                  SAM1     356
      PSAC=PSAC*PS(LEV,K)                                               SAM1     357
      CPSAC=CPSAC*CPST(LEV,K)                                           SAM1     358
      PKAC(LEV)=1.0-PSAC                                                SAM1     359
   89 CPKAC(LEV)=1.0-CPSAC                                              SAM1     360
      WRITE(6,4005)((HEAD4(J),J=1,3),LEV=1,NLEVS)                       SAM1     361
      WRITE(6,4001)((KLEV(J,LEV),J=1,2),LEV=1,NLEVS)                    SAM1     362
      WRITE(6,4002)((HEAD5(J),J=1,3),LEV=1,NLEVS)                       SAM1     363
      WRITE(6,4002)((HEAD1(J),J=1,3),LEV=1,NLEVS)                       SAM1     364
      WRITE(6,4002)((HEAD6(J),J=1,3),LEV=1,NLEVS)                       SAM1     365
      WRITE(6,4002)((HEAD3(J),J=1,3),LEV=1,NLEVS)                       SAM1     366
      WRITE(6,4002)((HEAD4(J),J=1,3),LEV=1,NLEVS)                       SAM1     367
      WRITE(6,4007)(PKAC(LEV),CPKAC(LEV),LEV=1,NLEVS)                   SAM1     368
 4007 FORMAT(8X,4(F14.3,F17.3))                                         SAM1     369
      WRITE(6,4002)((HEAD4(J),J=1,3),LEV=1,NLEVS)                       SAM1     370
      IJ=1                                                              SAM1     371
      IJX=0                                                             SAM1     372
      MFLAG(I)=0.0                                                      SAM1     373
      NMIN=NMIN-1                                                       SAM1     374
      IF(IEDIT.GT.0) WRITE(IEDIT,5002)JV,(TITLE(J),J=1,2),I,MN(I),      SAM1     375
     1ISM,RX2,RX1,XP0,XB1,XB2,PKAC                                      SAM1     376
 5002 FORMAT(" 2",I2,2A4," 2",2I2,14A4)                                 SAM1     377
  999 XCMOLD(I)=XCM                                                     SAM1     378
      YCMOLD(I)=YCM                                                     SAM1     379
      ZCMOLD(I)=ZCM                                                     SAM1     380
 1000 CONTINUE                                                          SAM1     381
      RETURN                                                            SAM     1265
      ENTRY MISINT                                                      SAM     1266
      WRITE(6,3000)                                                     SAM     1267
 3000 FORMAT(25H0*****MISSILE TYPE 2*****)                              SAM     1268
      IF(HM .EQ. HMS) RETURN                                            SAM     1269
      NX5=0                                                             SAM     1270
      AFEAM=2.01                                                        SAM     1271
      TT1=EXP(-HM*10.)                                                  SAM     1272
      TT2=EXP(-HM*2.)                                                   SAM     1273
      TT3=EXP(-HM/.22)                                                  SAM     1274
      TT4=EXP(-HM)                                                      SAM     1275
      GM=HM*.125                                                        SAM     1276
      TX1(1)=EXP(-GM*10.)                                               SAM     1277
      TX1(2)=TX1(1)                                                     SAM     1278
      TX2(1)=EXP(-GM/.18)                                               SAM     1279
      TX2(2)=TX1(1)                                                     SAM     1280
      TXX1(1)=1.-TX1(1)                                                 SAM     1281
      TXX1(2)=TXX1(1)                                                   SAM     1282
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      RTT1(1)=.1/GM                                                     SAM     1283
      RTT1(2)=RTT1(1)                                                   SAM     1284
      TXX2(1)=1.-TX2(1)                                                 SAM     1285
      TXX2(2)=TXX1(1)                                                   SAM     1286
      RTT2(1)=.18/GM                                                    SAM     1287
      RTT2(2)=RTT1(2)                                                   SAM     1288
      HMS=HM                                                            SAM     1289
      RETURN                                                            SAM     1290
      ENTRY LAUNCH                                                      SAM     1291
      DO 1500 J = 1, 20                                                 SAM     1292
      IF (MFLAG(J) .LE.0 ) GO TO 1501                                   SAM     1293
 1500 CONTINUE                                                          SAM     1294
      KA=0                                                              SAM     1295
      RETURN                                                            SAM     1296
 1501 K=J                                                               SAM     1297
      DO 1502  L=1,6                                                    SAM     1298
 1502 RM(L,K)=0.                                                        SAM     1299
      VM(4,K)=10.                                                       SAM     1300
      V11(1,K)=10.                                                      SAM     1301
      V11(2,K)=0.                                                       SAM     1302
      V11(3,K)=0.                                                       SAM     1303
      MACHM(K)=0.0                                                      SAM     1304
      RHO=RA(1)**2+RA(2)**2                                             SAM     1305
      VM(5,K)=RA(5)+7.*(RA(1)*VA(2)-RA(2)*VA(1))/RHO                    SAM     1306
      VM(6,K)=.262+.892*(RA(6)+7.*(VA(3)*RHO-RA(3)*(RA(1)*VA(1)+RA(2)*VA SAM     1307
     1(2)))/(RHO*RA(4)**2))                                             SAM     1308
      IF(ABS(VM(5,K)) .GT. PI)  VM(5,K)=VM(5,K)-SIGN(2.*PI,VM(5,K))     SAM     1309
      CALL COORD(VM(1,K),2)                                             SAM     1310
      MFLAG(K)=1                                                        SAM     1311
      RAM(K)=RA(4)                                                      SAM     1312
      RAMD(K)=0.                                                        SAM     1313
      NMIN=NMIN+1                                                       SAM     1314
      NX5=NX5+1                                                         SAM     1315
      MN(K)=NX5                                                         SAM     1316
      IF(IEDIT .GT. 0) WRITE(IEDIT,5003) JV,(TITLE(J),J=1,2),I,MN(I),   SAM     1317
     1             TIME,(RA(J),J=1,3)                                   SAM     1318
 5003 FORMAT(2H 2,I2,2A4,2H 1,2I2,4A4)                                  SAM     1319
      X18(K)=-VM(5,K)                                                   SAM     1320
      X19(K)=VM(6,K)                                                    SAM     1321
      SX19(K)=SIN(X19(K))                                               SAM     1322
      CX19(K)=COS(X19(K))                                               SAM     1323
      SZS(K)=SIN(X18(K))                                                SAM     1324
      CZS(K)=COS(X18(K))                                                SAM     1325
      DO 1503  J1=1,2                                                   SAM     1326
      DEL(J1,K)=0.0                                                     SAM     1327
      VV(J1,K)=0.0                                                      SAM     1328
      ANY(J1,K)=0.                                                      SAM     1329
      CD1(J1,K)=0.                                                      SAM     1330
      CD2(J1,K)=0.                                                      SAM     1331
      CD3(J1,K)=0.                                                      SAM     1332
      AP(J1,K)=0.0                                                      SAM     1333
      ODS(J1,K)=0.0                                                     SAM     1334
      CCS(J1,K)=0.                                                      SAM     1335
```

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      CD2(J1,K)=0.                                        SAM     1336
      DO 1503  J2=1,2                                     SAM     1337
      DF2(J1,J2,K)=VM(7-J1,K)                             SAM     1338
      LY1(J1,J2,K)=0.0                                    SAM     1339
      LY2(J1,J2,K)=0.0                                    SAM     1340
      LX1(J1,J2,K)=0.                                     SAM     1341
 1503 LX2(J1,J2,K)=0.                                     SAM     1342
      TL(K)=TIME                                          SAM     1343
      DO 1504 J = 1,3                                     SAM     1344
      VMS(J,K)=VM(J,K)                                    SAM     1345
      AMIS(J,K)=0.                                        SAM     1346
 1504 OMEG(J,K)=0.                                        SAM     1347
      KA=K                                                SAM     1348
      IF(NMIN .GT. 1) RETURN                              SAM     1349
      CD3=PA(4)                                           SAM     1350
      DD3S=CD3                                            SAM     1351
      KFILL=1                                             SAM     1352
      RETURN                                              SAM     1353
      END                                                 SAM     1354
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      SUBROUTINE SPRAY(DLT,PSC)                                          SAM      1941
      COMMON /DRIVE/ TIME,HM,ISTART,TOTAL,EXTR(60),IEXTR(30),TITLE(18),  SAM1      382
     1DEG,G,PI,PAD                                                       SAM1      383
      COMMON /MISSL/ RM(6,20),VM(6,20),MACHM(20),QAM(20),SSA,AREAM,      SAM      1942
     1VV(2,20),DEL(2,20),AB(2,20),MN(20),RAM(20),RAMD(20)                SAM      1943
      COMMON /FLAGS/ JFOL,KFOL,JSAM,KSAM,LSAM,NMIN,ISTOP,IAC,IEDIT,      SAM      1944
     1IGUIDE,IMODE,MFLAG(20),JV                                          SAM      1945
      COMMON /AIRCF/ RA(6),VA(6),DUM(16),TIA(9)                          SAM1      384
      COMMON /ONE/ NCOMPS,NLEVS,NWTS,NSHLDS,NBLAST,NGLIT,THA,RCHA,VE,    SAM      1947
     1DELT,XCM,YCM,ZCM,VNETHI,I                                          SAM1      385
      COMMON /TWO/ XGL(25),YGL(25),ZGL(25),XSH(25),YSH(25),ZSH(25),      SAM      1949
     1ASH(25),BSH(25),CSH(25),XBL(25),YBL(25),ZBL(25),ABL(25),BBL(25),   SAM      1950
     2CBL(25),XCMOLD(20),YCMOLD(20),ZCMOLD(20),EX(25),WY(25),ZEE(25),    SAM      1951
     3TAM(9),TMI(9)                                                      SAM      1952
      COMMON /FIVE/ VUL(2,11,72),STEAR(19),FRACT(10),SLOW(10)            SAM1      386
      DIMENSION PSC(4,25),SUM(4),VT(3),VS(3)                             SAM      1953
      DELTA=0.5/VA(4)                                                    SAM1      387
      XSTAR=XCMOLD(I)+DLT*(XCM-XCMOLD(I))                                SAM      1954
      YSTAR=YCMOLD(I)+DLT*(YCM-YCMOLD(I))                                SAM      1955
      ZSTAR=ZCMOLD(I)+DLT*(ZCM-ZCMOLD(I))                                SAM      1956
      IF(NBLAST.LT.1) GO TO 102                                          SAM1      388
      DO 101 M=1,NBLAST                                                  SAM      1957
      IF(((XSTAR-XBL(M))/ABL(M))**2+((YSTAR-YBL(M))/BBL(M))**2+          SAM      1958
     1((ZSTAR-ZBL(M))/CBL(M))**2.GT.1.0) GO TO 101                       SAM      1959
      DO 100 K=1,NCOMPS                                                  SAM      1960
      DO 100 LEV=1,NLEVS                                                 SAM      1961
  100 PSC(LEV,K)=0.0                                                     SAM      1962
      RETURN                                                             SAM      1963
  101 CONTINUE                                                           SAM      1964
  102 VT(1)=TIA(1)*VA(1)+TIA(2)*VA(2)+TIA(3)*VA(3)                       SAM1      389
      VT(2)=TIA(4)*VA(1)+TIA(5)*VA(2)+TIA(6)*VA(3)                       SAM      1966
      VT(3)=TIA(7)*VA(1)+TIA(8)*VA(2)+TIA(9)*VA(3)                       SAM      1967
      VS(1)=TIA(1)*VM(1,I)+TIA(2)*VM(2,I)+TIA(3)*VM(3,I)                 SAM      1968
      VS(2)=TIA(4)*VM(1,I)+TIA(5)*VM(2,I)+TIA(6)*VM(3,I)                 SAM      1969
      VS(3)=TIA(7)*VM(1,I)+TIA(8)*VM(2,I)+TIA(9)*VM(3,I)                 SAM      1970
      VTVS=VT(1)*VS(1)+VT(2)*VS(2)+VT(3)*VS(3)                           SAM      1971
      A=VA(4)**2+VM(4,I)**2-VE**2-2.0*VTVS                               SAM      1972
      VRAT=VE/VM(4,I)                                                    SAM1      390
      VRAT2=VRAT**2                                                      SAM1      391
      DO 31 K=1,NCOMPS                                                   SAM      1973
      DX=EX(K)-XSTAR                                                     SAM      1974
      DY=WY(K)-YSTAR                                                     SAM      1975
      DZ=ZEE(K)-ZSTAR                                                    SAM      1976
      B=2.0*(DX*(VT(1)-VS(1))+DY*(VT(2)-VS(2))+DZ*(VT(3)-VS(3)))         SAM      1979
      C=DX**2+DY**2+DZ**2                                                SAM      1980
      D=B*B-4.0*A*C                                                      SAM      1981
      IF(D.GE.0.0) GO TO 3                                               SAM      1982
    1 DO 2 LEV=1,NLEVS                                                   SAM      1983
    2 PSC(LEV,K)=1.0                                                     SAM      1984
      GO TO 31                                                           SAM      1985
    3 T1=(-B+SQRT(D))/(2.0*A)                                            SAM      1986
      T2=(-B-SQRT(D))/(2.0*A)                                            SAM      1987
      IF(T1.GE.0.0) GO TO 4                                              SAM      1988
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      IF(T2.LT.0.0) GO TO 1                                             SAM    1989
      TEST=T2                                                           SAM    1990
      GO TO 6                                                           SAM    1991
    4 IF(T2.GT.0.0) GO TO 5                                             SAM    1992
      TEST=T1                                                           SAM    1993
      GO TO 6                                                           SAM    1994
    5 TEST=AMIN1(T1,T2)                                                 SAM    1995
    6 DO 7 LEV=1,NLEVS                                                  SAM    1996
    7 SUM(LEV)=0.0                                                      SAM    1997
      DO 28 KWT=1,NWTS                                                  SAM    1998
      KOUNT=0                                                           SAM    1999
    8 ELX=DX+VT(1)*TEST                                                 SAM    2000
      ELY=DY+VT(2)*TEST                                                 SAM    2001
      ELZ=DZ+VT(3)*TEST                                                 SAM    2002
      EL=SQRT(ELX**2+ELY**2+ELZ**2)                                     SAM    2003
      KOUNT=KOUNT+1                                                     SAM    2004
      BETAX=ELX/EL                                                      SAM    2005
      BETAY=ELY/EL                                                      SAM    2006
      BETAZ=ELZ/EL                                                      SAM    2007
      ELDOT=BETAX*VT(1)+BETAY*VT(2)+BETAZ*VT(3)                         SAM    2008
      COSGAM=(BETAZ*VS(1)+BETAY*VS(2)+BETAZ*VS(3))/VM(4,I)              SAM    2009
      VZERO=VM(4,I)*COSGAM+SQRT((VM(4,I)*COSGAM)**2+VE**2-VM(4,I)**2)   SAM    2010
      F=SLOW(KWT)*EL-ALOG(1.0+SLOW(KWT)*VZERO*TEST)                     SAM    2011
      VODOT=VZERO*(VTVS-ELDOT*VM(4,I)*COSGAM)/                          SAM    2012
     1(EL*(VZERO-VM(4,I)*COSGAM))                                       SAM    2013
      FPRIME=SLOW(KWT)*(ELDOT-(VZERO+VODOT*TEST)/                       SAM    2014
     1(1.0+SLOW(KWT)*VZERO*TEST))                                       SAM    2015
      IF(FPRIME.GE.0.0) GO TO 28                                        SAM    2016
      TNEW=TEST-F/FPRIME                                                SAM    2017
      IF(TNEW.LT.0.0) GO TO 28                                          SAM    2018
      IF(ABS(TNEW-TEST).LE.DELTA) GO TO 10                              SAM    2019
      IF(KOUNT.GT.10) GO TO 28                                          SAM    2020
    9 TEST=TNEW                                                         SAM    2021
      GO TO 8                                                           SAM    2022
   10 SDOWN=EXP(-SLOW(KWT)*EL)                                          SAM    2023
      COSTHT=(VZERO*COSGAM-VM(4,I))/VE                                  SAM    2024
      IF(ABS(COSTHT).GT.1.0) COSTHT=SIGN(1.0,COSTHT)                    SAM    2025
      XTG=VT(1)*TEST                                                    SAM    2026
      YTG=VT(2)*TEST                                                    SAM    2027
      ZTG=VT(3)*TEST                                                    SAM    2028
      IF(NSHLDS.LT.1) GO TO 15                                          SAM1    392
      IF(BETAX.EQ.0.0) GO TO 9                                          SAM    2030
      DO 14 L=1,NSHLDS                                                  SAM    2031
      IF(EX(K).NE.XSH(L)) GO TO 11                                      SAM    2032
      IF(WY(K).NE.YSH(L)) GO TO 11                                      SAM    2033
      IF(ZEE(K).EQ.ZSH(L)) GO TO 14                                     SAM    2034
   11 DX=(XSH(L)+XTG-XSTAR)/ASH(L)                                      SAM    2035
      DY=(YSH(L)+YTG-YSTAR)/BSH(L)                                      SAM    2036
      DZ=(ZSH(L)+ZTG-ZSTAR)/CSH(L)                                      SAM    2037
      TXY=(BETAY*ASH(L))/(BETAX*BSH(L))                                 SAM    2038
      TXZ=(BETAZ*ASH(L))/(BETAX*CSH(L))                                 SAM    2039
      A=1.0+TXY**2+TXZ**2                                               SAM    2040
      B=-2.0*(DX+TXY*DY+TXZ*DZ)                                         SAM    2041
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```
      C=DX**2+DY**2+DZ**2-1.0
      D=B*B-4.0*A*C
      IF(D.LE.0.0) GO TO 14
      D=SQRT(D)
      DO 13 LL=1,2
      XDIM=(-B+D*(-1.0**LL))/(2.0*A)
      XPUNCH=XSTAR+XDIM*ASH(L)
      IF(XPUNCH.LE.XSTAR) GO TO 12
      IF(EX(K)+XTG-XSTAR.GT.XPUNCH) GO TO 28
      GO TO 13
   12 IF(EX(K)+XTG-XSTAR.LT.XPUNCH) GO TO 28
   13 CONTINUE
   14 CONTINUE
   15 THETA=ATAN2(SQRT(1.0-COSTHT**2),COSTHT)
      KANG=18.0*THETA/PI+1.0
      IF(KANG.NE.19) GO TO 16
      STIR=STEAR(19)
      GO TO 17
   16 STIR=STEAR(KANG)+(STEAR(KANG+1)-STEAR(KANG))*
     1(18.0*THETA/PI+1.0-KANG)
   17 VHIT=VZERO*SDOWN
      VNET=SQRT((VHIT*BETAX-VT(1))**2+(VHIT*BETAY-VT(2))**2+
     1(VHIT*BETAZ-VT(3))**2)
      KV=10.0*VNET/VNETHI+1.0
      SPREAD=VRAT2*ABS(VRAT+COSTHT)/(VRAT2+2.0*VRAT*COSTHT+1.0)**1.5
      DO 27 IXYZ=1,3
      IF(IXYZ-2)18,20,22
   18 SHAD=ABS(BETAX)
      IF(BETAX.GE.0.0) GO TO 19
      IFACE=1
      GO TO 24
   19 IFACE=0
      GO TO 24
   20 SHAD=ABS(BETAY)
      IF(BETAY.GE.0.0) GO TO 21
      IFACE=3
      GO TO 24
   21 IFACE=2
      GO TO 24
   22 SHAD=ABS(BETAZ)
      IF(BETAZ.GE.0.0) GO TO 23
      IFACE=4
      GO TO 24
   23 IFACE=5
   24 KFACE=6*K-IFACE
      JINDEX=NWTS*(KFACE-1)+KWT
      DO 26 LEV=1,NLEVS
      IF(KV.LT.11) GO TO 25
      VAREA=VUL(LEV,11,JINDEX)
      GO TO 26
   25 VAREA=VUL(LEV,KV,JINDEX)+(10.0*VNET/VNETHI+1.0-KV)*
     1(VUL(LEV,KV+1,JINDEX)-VUL(LEV,KV,JINDEX))
   26 SUM(LEV)=SUM(LEV)+STIR*FRACT(KWT)*VAREA*SHAD/(SPREAD*EL**2)
```

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SUBROUTINE SPRAY       74/74    OPT=1                FTN 4.6+420        77/08/04. 14.10.44       PAGE     4

            27 CONTINUE                                                        SAM      2095
            28 CONTINUE                                                        SAM      2096
               DO 30 LEV=1,NLEVS                                               SAM      2097
               IF(SUM(LEV).LT.9.0) GO TO 29                                    SAM      2098
               PSC(LEV,K)=0.0                                                  SAM      2099
               GO TO 30                                                        SAM      2100
            29 PSC(LEV,K)=EXP(-SUM(LEV))                                       SAM      2101
            30 CONTINUE                                                        SAM      2102
            31 CONTINUE                                                        SAM      2103
               RETURN                                                          SAM      2104
               END                                                             SAM      2105
```

```
      SUBROUTINE STAB(XO,YO,ZO,XS,YS,ZS,N,DLT)                          SAM    2106
      COMMON /MISSL/ RM(6,20),VM(6,20),MACHM(20),QAM(20),SSA,AREAM,     SAM    2107
     1VV(2,20),DEL(2,20),AE(2,20),MN(20),RAF(20),RAFD(20)               SAM    2108
      COMMON /FLAGS/ JPOL,KPOL,JSAM,KSAM,LSAM,NMIN,ISTOP,IAC,IEDIT,     SAM    2109
     1IGUIDE,IMODE,MFLAG(20),JV                                         SAM    2110
      COMMON /AIRCF/ DUM(28),TIA(9)                                     SAM    2111
      COMMON /ONE/ NCOMPS,NLEVS,NWTS,NSHLDS,NBLAST,NGLIT,THA,RCHA,VE,   SAM    2112
     1DELT,XCM,YCM,ZCM,VNETHI,I                                         SAM1    393
      COMMON /TWO/ XGL(25),YGL(25),ZGL(25),XSH(25),YSH(25),ZSH(25),     SAM    2114
     1ASH(25),BSH(25),CSH(25),XBL(25),YBL(25),ZBL(25),ABL(25),BBL(25),  SAM    2115
     2CBL(25),XCMOLD(20),YCMOLD(20),ZCMOLD(20),EX(25),WY(25),ZEE(25),   SAM    2116
     3TAM(9),TMI(9)                                                     SAM    2117
      DIMENSION XO(25),YO(25),ZO(25),XS(25),YS(25),ZS(25)               SAM    2118
      DLT=2.0                                                           SAM    2119
      IF(N.LT.1) RETURN                                                 SAM    2120
      DX=XCMOLD(I)-XCM                                                  SAM    2121
      DY=YCMOLD(I)-YCM                                                  SAM    2122
      DZ=ZCMOLD(I)-ZCM                                                  SAM    2123
      DO 4 J=1,N                                                        SAM    2124
      IF(DZ.EQ.0.0) GO TO 1                                             SAM    2125
      XY2=(XS(J)*YS(J))**2                                              SAM    2126
      XZ2=(XS(J)*ZS(J))**2                                              SAM    2127
      YZ2=(YS(J)*ZS(J))**2                                              SAM    2128
      TXZ=XCM*ZCMOLD(I)-XCMOLD(I)*ZCM+XO(J)*DZ                          SAM    2129
      TYZ=YCM*ZCMOLD(I)-YCMOLD(I)*ZCM+YO(J)*DZ                          SAM    2130
      A=XY2*DZ**2+XZ2*DY**2+YZ2*DX**2                                   SAM    2131
      B=-2.0*(DX*YZ2*TXZ+DY*XZ2*TYZ+DZ**2*XY2*ZO(J))                    SAM    2132
      C=XZ2*TYZ**2+YZ2*TXZ**2+XY2*DZ**2*(ZO(J)**2-ZS(J)**2)             SAM    2133
      D=B*B-4.0*A*C                                                     SAM    2134
      IF(D.LT.0.0) GO TO 4                                              SAM    2135
      D=SQRT(D)                                                         SAM    2136
      Z3=(-B+SIGN(D,DZ))/(2.0*A)                                        SAM    2137
      DELL=(ZCMOLD(I)-Z3)/DZ                                            SAM    2138
      GO TO 3                                                           SAM    2139
    1 IF(DY.EQ.0.0) GO TO 2                                             SAM    2140
      A=(YS(J)*DX)**2+(XS(J)*DY)**2                                     SAM    2141
      TXY=XCM*YCMOLD(I)-XCMOLD(I)*YCM+XO(J)*DY                          SAM    2142
      XY2=(XS(J)*DY)**2                                                 SAM    2143
      B=2.0*(YS(J)**2*DX*TXY-XY2*YO(J))                                 SAM    2144
      C=(YS(J)*TXY)**2+XY2*(YO(J)**2+YS(J)**2)*                         SAM    2145
     1(((ZCM-ZO(J))/ZS(J))**2-1.0)                                      SAM    2146
      D=B*B-4.0*A*C                                                     SAM    2147
      IF(D.LT.0.0) GO TO 4                                              SAM    2148
      D=SQRT(D)                                                         SAM    2149
      Y3=(-B+SIGN(D,DY))/(2.0*A)                                        SAM    2150
      DELL=(YCMOLD(I)-Y3)/DY                                            SAM    2151
      GO TO 3                                                           SAM    2152
    2 IF(DX.EQ.0.0) RETURN                                              SAM    2153
      TYZ=1.0-((ZCM-ZO(J))/ZS(J))**2-((YCM-YO(J))/YS(J))**2             SAM    2154
      IF(TYZ.LT.0.0) GO TO 4                                            SAM    2155
      TYZ=SQRT(TYZ)                                                     SAM    2156
      X3=XO(J)+XS(J)*SIGN(TYZ,DX)                                       SAM    2157
      DELL=(XCMOLD(I)-X3)/DX                                            SAM    2158
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    3 IF(DELL.LT.0.0) GO TO 4                                 SAM     2159
      IF(DELL.LT.DLT) DLT=DELL                                SAM     2160
    4 CONTINUE                                                SAM     2161
      RETURN                                                  SAM     2162
      END                                                     SAM     2163
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      SUBROUTINE CONFUZE                                                SAM     2164
      COMMON /MISSL/ RM(6,20),VM(6,20),MACHM(20),QAM(20),SSA,AREAM,     SAM     2165
     1VV(2,20),DEL(2,20),AB(2,20),MN(20),RAM(20),RAPD(20)               SAM     2166
      COMMON /FLAGS/ JPOL,KPOL,JSAM,KSAM,LSAM,NMIN,ISTOP,IAC,IEDIT,     SAM     2167
     1IGUIDE,IMODE,MFLAG(20),JV                                         SAM     2168
      COMMON /AIRCF/ DUM(28),TIA(9)                                     SAM     2169
      COMMON /ONE/ MCOMPS,NLEVS,NHTS,NSHLDS,NBLAST,NGLIT,THA,RCHA,VE,   SAM     2170
     1DELT,XCM,YCM,ZCM,VNETHI,I                                         SAM1     394
      COMMON /TWO/ XGL(25),YGL(25),ZGL(25),XSH(25),YSH(25),ZSH(25),     SAM     2172
     1ASH(25),BSH(25),CSH(25),XBL(25),YBL(25),ZBL(25),ABL(25),BBL(25),  SAM     2173
     2CBL(25),XCMOLD(20),YCMOLD(20),ZCMOLD(20),EX(25),WY(25),ZEE(25),   SAM     2174
     3TAM(9),THI(9)                                                     SAM     2175
      REAL XG(2),YG(2),ZG(2)                                            SAM     2176
      DELT=2.0                                                          SAM     2177
      DO 10 IGL=1,NGLIT                                                 SAM     2178
      T1=XGL(IGL)-XCMOLD(I)                                             SAM     2179
      T2=YGL(IGL)-YCMOLD(I)                                             SAM     2180
      T3=ZGL(IGL)-ZCMOLD(I)                                             SAM     2181
      XG(1)=TAM(1)*T1+TAM(2)*T2+TAM(3)*T3                               SAM     2182
      YG(1)=TAM(4)*T1+TAM(5)*T2+TAM(6)*T3                               SAM     2183
      ZG(1)=TAM(7)*T1+TAM(8)*T2+TAM(9)*T3                               SAM     2184
      T1=XGL(IGL)-XCM                                                   SAM     2185
      T2=XGL(IGL)-YCM                                                   SAM     2186
      T3=XGL(IGL)-ZCM                                                   SAM     2187
      XG(2)=TAM(1)*T1+TAM(2)*T2+TAM(3)*T3                               SAM     2188
      YG(2)=TAM(4)*T1+TAM(5)*T2+TAM(6)*T3                               SAM     2189
      ZG(2)=TAM(7)*T1+TAM(8)*T2+TAM(9)*T3                               SAM     2190
      IF(THA.GT.0.0) GO TO 1                                            SAM     2191
      XG(1)=-XG(1)                                                      SAM     2192
      XG(2)=-XG(2)                                                      SAM     2193
    1 DX=XG(1)-XG(2)                                                    SAM     2194
      DY=YG(1)-YG(2)                                                    SAM     2195
      DZ=ZG(1)-ZG(2)                                                    SAM     2196
      IF(DX.NE.0.0) GO TO 4                                             SAM     2197
      IF(XG(1).LT.0.0) GO TO 10                                         SAM     2198
      IF(XG(1).GT.RCHA) GO TO 10                                        SAM     2199
      IF(DZ.NE.0.0) GO TO 2                                             SAM     2200
      IF(DY.EQ.0.0) GO TO 10                                            SAM     2201
      Y3=(XG(1)*THA)**2-ZG(1)**2                                        SAM     2202
      IF(Y3.LT.0.0) GO TO 10                                            SAM     2203
      Y3=SIGN(SQRT(Y3),DY)                                              SAM     2204
      DELTT=(YG(1)-Y3)/DY                                               SAM     2205
      IF(DELTT.GT.1.0) GO TO 10                                         SAM     2206
      IF(DELTT.GE.0.0) GO TO 9                                          SAM     2207
      DELTT=(YG(1)+Y3)/DY                                               SAM     2208
      GO TO 7                                                           SAM     2209
    2 A=DY**2+DZ**2                                                     SAM     2210
      TEMP=YG(1)*ZG(2)-YG(2)*ZG(1)                                      SAM     2211
      B=-2.0*TEMP*DY                                                    SAM     2212
      C=TEMP**2-(XG(1)*THA*DZ)**2                                       SAM     2213
      D=B*B-4.0*A*C                                                     SAM     2214
      IF(D.LT.0.0) GO TO 10                                             SAM     2215
      D=SQRT(D)                                                         SAM     2216
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      Z3=(-B+SIGN(D,DZ))/(2.0*A)                                  SAM     2217
      DELTT=(ZG(1)-Z3)/DZ                                         SAM     2218
      IF(DELTT.LT.0.0) GO TO 3                                    SAM     2219
      IF(DELTT.GT.1.0) 10,9                                       SAM     2220
    3 Z3=(-B-SIGN(D,DZ))/(2.0*A)                                  SAM     2221
      DELTT=(ZG(1)-Z3)/DZ                                         SAM     2222
      GO TO 7                                                     SAM     2223
    4 A=DY**2+DZ**2-(DX*THA)**2                                   SAM     2224
      T1=YG(2)*XG(1)-YG(1)*XG(2)                                  SAM     2225
      T2=ZG(2)*XG(1)-ZG(1)*XG(2)                                  SAM     2226
      B=2.0*(T1*DY+T2*DZ)                                         SAM     2227
      C=T1**2+T2**2                                               SAM     2228
      IF(A.NE.0.0) GO TO 5                                        SAM     2229
      IF(B.GE.0.0) GO TO 10                                       SAM     2230
      X3=-C/B                                                     SAM     2231
      IF(X3.GT.RCHA) GO TO 10                                     SAM     2232
      DELTT=(XG(1)-X3)/DX                                         SAM     2233
      GO TO 7                                                     SAM     2234
    5 D=B*B-4.0*A*C                                               SAM     2235
      IF(D.LT.0.0) GO TO 10                                       SAM     2236
      D=SQRT(D)                                                   SAM     2237
      X3=(-B+SIGN(D,A*DX))/(2.0*A)                                SAM     2238
      IF(X3.LT.0.0) GO TO 10                                      SAM     2239
      IF(X3.GT.RCHA) GO TO 6                                      SAM     2240
      DELTT=(XG(1)-X3)/DX                                         SAM     2241
      IF(DELTT.GE.0.0) GO TO 8                                    SAM     2242
    6 X3=(-B-SIGN(D,A*DX))/(2.0*A)                                SAM     2243
      IF(X3.LT.0.0) GO TO 10                                      SAM     2244
      IF(X3.GT.RCHA) GO TO 10                                     SAM     2245
      DELTT=(XG(1)-X3)/DX                                         SAM     2246
    7 IF(DELTT.LT.0.0) GO TO 10                                   SAM     2247
    8 IF(DELTT.GT.1.0) GO TO 10                                   SAM     2248
    9 IF(DELTT.LT.DELT) DELT=DELTT                                SAM     2249
   10 CONTINUE                                                    SAM     2250
      RETURN                                                      SAM     2251
      END                                                         SAM     2252
```

SECTION 5

DEFINITION OF FORTRAN VARIABLES

The following pages of this section list and define those FORTRAN variables which have been added to the DSAMAM program for the endgame. Also shown is the common block in which the variable is found or, if it is not in common, the subroutine which uses it. Finally, there is an indication at to whether the value of the variable is read as input or computed internally.

FORTRAN Variable	Input or Internal	Common Block or Subroutine Where Found	Definition
ABL(I)	Input	/TWO/	For the Ith blast ellipsoid, the length of the semi-axis in the X-direction of the aircraft body system (ft)
ASH(I)	Input	/TWO/	For the Ith fragment shield ellipsoid, the length of the semi-axis in the X-direction of the aircraft body system (ft)
BBL(I)	Input	/TWO/	For the Ith blast ellipsoid, the length of the semi-axis in the Y-direction of the aircraft body system (ft)
BETAX	Internal	SPRAY	Direction cosine with respect to the X-axis of the aircraft body system of the line traversed by the fragment
BETAY	Internal	SPRAY	Direction cosine with respect to the Y-axis of the aircraft body system of the line traversed by the fragment
BETAZ	Internal	SPRAY	Direction cosine with respect to the Z-axis of the aircraft body system of the line traversed by the fragment
BSH(I)	Input	/TWO/	For the Ith fragment shield ellipsoid, the length of the semi-axis in the Y-direction of the aircraft body system (ft)
CBL(I)	Input	/TWO/	For the Ith blast ellipsoid, the length of the semi-axis in the Z-direction of the aircraft body system (ft)
CDR	Input	/THREE/	Fragment drag coefficient

FORTRAN Variable	Input or Internal	Common Block or Subroutine Where Found	Definition
COSGAM	Internal	SPRAY	Cosine of the angle between the missile velocity and the velocity vector of the fragment in a dynamic explosion
COSTHT	Internal	SPRAY	Cosine of the angle between the missile velocity vector and the velocity vector of the fragment in a static explosion
CPS(I,J)	Internal	/SIX/	Cumulative survival probability for component J at kill level I
CPKAC(I)	Internal	MISSIL	Cumulative overall aircraft kill probability at kill level I
CPST(I,J)	Internal	MISSIL	Cumulative survival probability for component J at kill level I adjusted for doubly vulnerable pairs in order to calculate overall aircraft kill probability
CSH(I)	Input	/TWO/	For the Ith fragment shield ellipsoid, the length of the semi-axis in the Z-direction of the aircraft body system (ft)
DELT	Internal	/ONE/	That fraction of the time increment between two integration points at which radar fuzing occurs
DTCF	Input	/THREE/	Delay time of the contact fuze (sec.)
DTRF	Input	/THREE/	Delay time of the radar fuze (sec.)
EL	Internal	SPRAY	The distance traveled by a fragment before hitting an aircraft component (ft)

FORTRAN Variable	Input or Internal	Common Block or Subroutine Where Found	Definition
ELDOT	Internal	SPRAY	Rate of change of EL with respect to time (ft/sec).
EX(I)	Input	/TWO/	X-coordinate in the aircraft body system of the center of gravity of the Ith vulnerable component (ft).
F	Internal	SPRAY	A function of time whose roots represent solutions for the intersection of the fragment and an aircraft component.
FPRIME	Internal	SPRAY	The rate of change of F with respect to time.
FRACT(I)	Input	/FIVE/	Fraction by number of all fragments belonging to fragment mass class I.
HAFANG	Input	/THREE/	Half-angle of the radar fuze (degrees).
HEAD1(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
HEAD2(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
HEAD3(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
HEAD4(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
HEAD5(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
HEAD6(I)	Internal	MISSIL	Printout heading. I has a maximum value of 3.
I	Internal	/ONE/	Index which points to the particular missile in the air being considered. This variable is also used as a temporary index in other parts of the program which do not relate to the endgame.

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
KLEV(I,J)	Internal	MISSIL	Printout heading which designates kill level J. I has a maximum value of 2.
NBLAST	Input	/ONE/	Number of blast ellipsoids.
NCOMPS	Input	/ONE/	Number of vulnerable components (including doubly vulnerable components).
NDHK	Input	/THREE/	Number of direct-hit-with-kill ellipsoids.
NDHNK	Input	/THREE/	Number of direct-hit-no-kill ellipsoids.
NDUBLY	Input	/THREE/	Number of pairs of doubly vulnerable components.
NGLIT	Input	/ONE/	Number of glitter points.
NLEVS	Input	/ONE/	Number of kill levels.
NSHLDS	Input	/ONE/	Number of shield ellipsoids.
NWTS	Input	/ONE/	Number of fragment mass classes.
PDCF	Input	/THREE/	Probability that the contact fuze is a dud.
PDRF	Input	/THREE/	Probability that the radar fuze is a dud.
PKAC(I)	Internal	MISSIL	Single-shot overall aircraft kill probability at kill level I.
PS(I,J)	Internal	MISSIL	Single-shot survival probability for component J at kill level I.
PSCF(I,J)	Internal	MISSIL	Single-shot survival probability for component J at kill level I due to detonation initiated by contact fuze.

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
PSRF(I,J)	Internal	MISSIL	Single-shot survival probability for component J at kill level I due to detonation initiated by radar fuze.
RADFUZE	Internal	MISSIL	Indicator set to .TRUE. if radar fuze is activated - otherwise .FALSE.
RCHA	Internal	/ONE/	Maximum range of the radar fuze multiplied by the cosine of the radar fuze half-angle (ft).
RMISS	Input	/THREE/	Range outside of which the missile is considered to have missed after having passed the point of closest approach to the target (ft).
SDOWN	Internal	SPRAY	The fraction of its initial velocity to which a fragment slows down after traveling a distance EL.
SLOW(I)	Internal	/FIVE/	Slowdown constant for fragments of mass class I (ft^{-1}).
SPREAD	Internal	SPRAY	Factor which when multiplied by the dynamic fragment density gives the fragment density for a static explosion.
STEAR(I)	Input	/FIVE/	Static fragment density (fragments/steradian). The index I represents 19 points from 0^o to 180^o off the nose at 10^o intervals.
SUM(I)	Internal	SPRAY	Expected number of hits capable of producing kill level I on a component.

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
TAM(I)	Internal	/TWO/	Transformation matrix between the aircraft body coordinate system and the missile body coordinate system. The index I runs from 1 to 9 starting at the upper left of the matrix and proceeding left to right across the three rows of the matrix.
THA	Internal	/ONE/	Tangent of the radar fuze half-angle.
THETA	Internal	SPRAY	Angle between the missile velocity vector and the fragment velocity vector in a static explosion (radians).
TIA(I)	Internal	/AIRCF/	Transformation matrix between the aircraft body coordinate system and the inertial coordinate system. The index I runs from 1 to 9 starting at the upper left of the matrix and proceeding left to right across the three rows of the matrix.
TMI(I)	Internal	/TWO/	Transformation matrix between the missile body coordinate system and the inertial coordinate system. The index I runs from 1 to 9 starting at the upper left of the matrix and proceeding left to right across the three rows of the matrix.
VE	Input	/THREE/	Fragment static emission speed (ft/sec).
VHIT	Internal	SPRAY	The speed of the striking fragment (ft/sec).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
VNET	Internal	SPRAY	The net striking speed of the fragment (i.e., the magnitude of the relative velocity vector between the fragment and the aircraft) (ft/sec).
VNETHI	Input	/ONE/	Normalizing velocity for vulnerable area inputs. Values are read for each of the 11 net striking velocities corresponding to 0, 0.1, 0.2,...1.0 times VNETHI (ft/sec).
VODOT	Internal	SPRAY	Rate of change of VZERO with respect to time (ft/sec^2).
VS(I)	Internal	SPRAY	Missile velocity vector in the aircraft body system (ft/sec).
VT(I)	Internal	SPRAY	Aircraft velocity vector in the aircraft body system (ft/sec).
VUL(I,J,K)	Input	/FIVE/	Vulnerable area (ft^2). The index I represents kill level. The index J represents 11 levels of net striking speed. The index K combines aspect, fragment mass class, and component.
VX	Internal	MISSIL	X-component in the inertial coordinate system of the relative velocity vector of the aircraft with respect to the missile (ft/sec).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
VY	Internal	MISSIL	Y-component in the inertial coordinate system of the relative velocity vector of the aircraft with respect to the missile (ft/sec).
VZ	Internal	MISSIL	Z-component in the inertial coordinate system of the relative velocity vector of the aircraft with respect to the missile (ft/sec).
VZERO	Internal	SPRAY	Magnitude of the dynamic velocity vector of the fragment (ft/sec).
WATE(I)	Input	/FOUR/	Average weight of fragments in mass class I (grains).
WY(I)	Input	/TWO/	Y-coordinate in the aircraft body system of the center of gravity of the Ith vulnerable component (ft.).
XBL(I)	Input	/TWO/	X-coordinate in the aircraft body system of the center of the Ith blast ellipsoid (ft.).
XCG	Internal	MISSIL	X-coordinate in the inertial system of the center of gravity of the aircraft relative to the missile (ft.).
XCM	Internal	/ONE/	X-coordinate in the aircraft body system of the missile currently being considered (ft.).
XCMOLD(I)	Internal	/TWO/	X-coordinate in the aircraft body system of missile I at the previous time step (ft.).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
XG(I)	Internal	CONFUZE	X-coordinate in the missile body system of the glitter point. The index I is 1 for the previous time pulse and 2 for the current time pulse.
XGL(I)	Input	/TWO/	X-coordinate in the aircraft body system of the Ith glitter point (ft.).
XO(I,J)	Input	/FOUR/	X-coordinate in the aircraft body system of the center of the Ith direct-hit ellipsoid of type J (ft.). The type, J, specifies direct-hit-without kill (J=1) or direct-hit-with-kill (j=2).
XS(I,J)	Input	/FOUR/	For the Ith direct-hit ellipsoid of type J, the length of the semi-axis in the X-direction of the aircraft body system (ft.). The type, J, specifies direct-hit-without-kill (J=1) or direct-hit-with-kill (J=2).
XSH(I)	Input	/TWO/	X-coordinate in the aircraft body system of the center of the Ith fragment shield ellipsoid (ft.).
XSTAR	Internal	SPRAY	X-coordinate in the aircraft body system of the explosion point (ft.).
YBL(I)	Input	/TWO/	Y-coordinate in the aircraft body system of the center of the Ith blast ellipsoid (ft.).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
YCG	Internal	MISSIL	Y-coordinate in the inertial system of the center of gravity of the aircraft relative to the missile (ft.).
YCM	Internal	/ONE/	Y-coordinate in the aircraft body system of the missile currently being considered (ft.).
YCMOLD(I)	Internal	/TWO/	Y-coordinate in the aircraft body system of missile I at the previous time step (ft.).
YG(I)	Internal	CONFUZE	Y-coordinate in the missile body system of the glitter point. The index I is 1 for the previous time pulse and 2 for the current time pulse.
YGL(I)	Input	/TWO/	Y-coordinate in the aircraft body system of the Ith glitter point (ft.).
YO(I,J)	Input	/FOUR/	Y-coordinate in the aircraft body system of the center of the Ith direct-hit ellipsoid of type J (ft.). The type, J, specifies direct-hit-without-kill (J=1) or direct-hit-with-kill (J=2).
YS(I,J)	Input	/FOUR/	For the Ith direct-hit ellipsoid of type J, the length of the semi-axis in the Y-direction of the aircraft body system (ft.). The type, J, specifies direct-hit-without-kill (J=1) or direct-hit-with-kill (J=2).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
YSH(I)	Input	/TWO/	Y-coordinate in the aircraft body system of the center of the Ith fragment shield ellipsoid (ft.).
YSTAR	Internal	SPRAY	Y-coordinate in the aircraft body system of the explosion point (ft.).
ZBL(I)	Input	/TWO/	Z-coordinate in the aircraft body system of the center of the Ith blast ellipsoid (ft.).
ZCG	Internal	MISSIL	Z-coordinate in the inertial system of the center of gravity of the aircraft relative to the missile (ft.).
ZCM	Internal	/ONE/	Z-coordinate in the aircraft body system of the missile currently being considered (ft.).
ZCMOLD(I)	Internal	/TWO/	Z-coordinate in the aircraft body system of missile I at the previous time step.
ZEE(I)	Input	/TWO/	Z-coordinate in the aircraft body system of the center of gravity of the Ith vulnerable component (ft.).
ZG(I)	Internal	CONFUZE	Z-coordinate in the missile body system of the glitter point. The index I is 1 for the previous time pulse and 2 for the current time pulse.
ZGL(I)	Input	/TWO/	Z-coordinate in the aircraft body system of the Ith glitter point (ft.).

FORTRAN Variable	Input or Internal	Common Block of Subroutine Where Found	Definition
ZO(I,J)	Input	/FOUR/	Z-coordinate in the aircraft body system of the center of the Ith direct-hit ellipsoid of type J (ft.). The type, J, specifies direct-hit-without-kill (J=1) or direct-hit-with-kill (J=2).
ZS(I,J)	Input	/FOUR/	For the Ith direct-hit ellipsoid of type J, the length of the semi-axis in the Z-direction of the aircraft body system (ft.). The type, J, specifies direct-hit-without-kill (J=1) or direct-hit-with-kill (J=2).
ZSH(I)	Input	/TWO/	Z-coordinate in the aircraft body system of the center of the Ith fragment shield ellipsoid (ft.).
ZSTAR	Internal	SPRAY	Z-coordinate in the aircraft body system of the explosion point (ft.).